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## **1.0 INTRODUCTION AND STUDY AREA BACKGROUND**

### **1.1 PURPOSE**

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The purpose of this section is to provide a preliminary evaluation of historical sediment data in the 17-mile tidal reach of the Passaic River Restoration Project Study Area. Previously, electronic historical data were obtained from various sources and were uploaded to the Passaic River Estuary Management Information System (PREmis) database. These sources are listed below.

- National Oceanic and Atmospheric Administration (NOAA)
- New York State Department of Environmental Conservation (NYSDEC)
- New York State Department of Health (NYSDOH)
- TAMS/EarthTech, Inc (TAMS)
- US Army Corps of Engineers (USACE)
- New York Corp of Engineers (NYCOE)
- US Environmental Protection Agency (USEPA)
- Tierra Solutions Inc (TSI)
- U.S. Fish and Wildlife Service (USFWS)

The data in PREmis provide information on samples collected and analyzed for various chemical and non-chemical parameters. Although the samples were collected from various media, the majority of the samples were collected from sediment. PREmis contains information beyond the Passaic River (such as the Hackensack River up to the Oradell Dam, Berry's Creek, Pierson Creek, Newark Bay, and the Arthur Kill and Kill van Kull); however, this evaluation only focuses on sediments within the 17-mile stretch of the Lower Passaic River. This stretch is further divided into five main river reaches based on river morphology: Point No Point Reach, Harrison Reach, Newark Reach, Kearny Reach, and Up-estuary Reach (Figure 1-1).

## **1.2 STUDY AREA CONDITIONS**

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### **1.2.1 Background**

The Passaic River drains a 935 square mile watershed, located in northern New Jersey and southern New York states. Down-estuary of Dundee Dam (Garfield, New Jersey) the Lower Passaic River is a tidal estuary with a connection to New York Harbor via Newark Bay. All or portions of 117 municipalities in eight New Jersey counties and 15 municipalities in two New York counties are located within the Passaic watershed (see Figure 1-1). The lower part of the river (down-estuary of the Dundee Dam) flows through a very urbanized, highly industrial area. Development has impacted the environment in this area through modifications to the natural hydrologic regime resulting from channelization, bridge support structures, and dams; creation of fast land in former aquatic habitats; shoreline hardening and other alterations; and an overall increase in impervious area throughout the watershed.

The Passaic River sediments are contaminated with a variety of chemicals, including: dioxin, polychlorinated biphenyls (PCBs), pesticides, total extractable petroleum hydrocarbons (TEPH), polycyclic aromatic hydrocarbons (PAHs), and metals. As a result, the New Jersey Department of Environmental Protection (NJDEP) has instituted a “do not eat” advisory/prohibition for both fish and shellfish caught in the Passaic River. Contaminated sediments underlying the Lower Passaic River are of concern to various federal and state regulatory agencies because they can cause a number of negative consequences in the following areas:

- Ecological health effects;
- Human health effects; and
- Economic impacts on navigational dredging disposal costs.



To address the contaminated sediments in the Passaic River, Occidental Chemical Company (OCC) entered into an *Administrative Order on Consent* with the USEPA in 1994. Chemical Land Holdings (CLH), on behalf of OCC, designed and executed a Remedial Investigation and Feasibility Study (RI/FS) Work Plan in the vicinity of the OCC facility. This RI/FS primarily focused on a 6-mile stretch of river that extended up-estuary from the abandoned ConRail Railroad Bridge, called the Passaic River Study Area (PRSA).

### **1.2.2 Geologic Setting**

The Study Area is situated within the Newark Basin portion of the Piedmont physiographic province, which is located between the Atlantic Coastal Province and the Appalachian Province. The Newark Basin is underlain by sedimentary rocks (sandstones, shales, limy shales, and conglomerates), igneous rocks (basalt and diabase), and metamorphic rocks (schists and gneiss). These rocks are from the mid-Triassic to early Jurassic periods. Bedrock underlying the Study Area is the Passaic Formation (Olsen *et al.* 1984; Nichols 1968), which consists of interbedded red-brown sandstones and shales.

Almost the entire Passaic River Basin, including the Study Area, was subjected to glacial erosion and deposition as a result of the last stage of the Wisconsin glaciation. Considerable quantities of stratified sand, silt, gravel and clay were deposited in a glacial lake covering the area. These glaciofluvial deposits overlie bedrock and underlie the meadowlands section of the Newark Basin.

### **1.2.3 Surface Water Hydrology**

The majority of the freshwater inflow to the Lower Passaic River (approximately 1,200 cubic feet per second [cfs] on average) is provided by the upper portion of the river (USACE, 1987; USGS, 1989). The Third River, a tributary which discharges to the Lower Passaic River approximately 6 miles down-estuary of the Dundee Dam,

contributes on average, an additional 21 cfs. Additional freshwater inflow can also come from three ungauged tributaries located down-estuary of the Third River, namely the Second River, Franks Creek and Lawyers Creek, and from urban runoff, including storm sewers and combined sewers outfalls (CSO) (Figures 1-1 and 1-2). Details of the CSOs down-estuary of the Dundee Dam, including CSO name, location and receiving waterbody are provided in Table 1-1, Figures 1-2 and 1-3. According to Suszkowski (1978) the ungauged flows between the Dundee Dam and Newark Bay contribute less than 10% of the total flow at the mouth of the Passaic River. The lower Passaic River is considered to have serious water quality problems, and is rated very poor in both the freshwater regime above the Dundee Dam, and below the dam in the saline tidal reaches (USACE 1987).

The Lower Passaic River is influenced by tidal flows for approximately 17 miles extending from Dundee Dam down-estuary to the confluence with Newark Bay. The mean tidal range (difference in height between mean high water and mean low water) at the New Jersey Turnpike Bridge (approximately 15 miles up-estuary from Newark Bay) is 5.1 feet (NOAA 1972) with a mean tide level (midway between mean low water and mean high water) at elevation 2.5 feet (NOAA 1972). The mean spring tide range (average semi-diurnal range occurring during the full and new moon periods) is 6.1 feet. Saline water conditions exist throughout the Study Area. The cross-sectional average river velocity due to freshwater flow in the Study Area is approximately 1 foot per second with a typical maximum tidal velocity of approximately 3 feet per second (USACE 1987). The velocities resulting from up-estuary freshwater flow conditions will not normally control the resuspension of bottom sediments (USACE 1987).

#### **1.2.4 Climate**

The information provided by USACE (1987) indicate that the climate for the Study Area and surrounding area is characteristic of the Middle Atlantic Seaboard where marked changes in weather are frequent, particularly in the spring and fall. Winters are

moderate with snowfall averaging approximately 34 inches annually from October through mid-April. Rainfall is moderate and distributed fairly uniformly throughout the year, averaging approximately 47 inches annually with an average of 121 rainy days per year, although the region may be influenced by seasonal tropical storms and hurricanes between June and November. Thunderstorm activity is most likely to occur in the summer, and northeasters, which bring strong northeast winds over the East as they move north along the Atlantic Coast leading to heavy rain, snow and coastal flooding to the East, usually occur from November to April. The average annual temperature in Newark is 54 degrees Fahrenheit (°F) with extremes from -26 °F to + 108 °F. Mean relative humidity varies from 67% to 73%. Prevailing winds in the Newark area are from the southwest with only small seasonal variations in direction. The mean wind direction for the winter months is west-northwest (13% of the time) while southwest winds (12% of the time) predominate during the summer. Mean wind speeds are generally highest during the winter and spring months (10 to 12 miles per hour), and lower (8 to 9 miles per hour) during the summer months with an average annual velocity of approximately 10 miles per hour.

#### **1.2.5 Shoreline Features**

Both shorelines of the Lower Passaic River are almost completely developed, consisting of man-made recreational areas as well as commercial and industrial properties. For the purpose of this document, the shoreline of the Passaic River will be defined as left and right shorelines from the up-estuary perspective. The thalweg of the river is generally in the center of the channel in straight sections and is observed to favor the outside bends of the meanders. The Lower Passaic River encompasses four complete navigational reaches (Point No Point, Harrison, Newark, and Kearny Reaches) and one partial USACE defined navigational reach (Up-estuary Reach) (Figure 1-1).

### **1.2.6 River Reaches**

#### ***Point No Point Reach***

The Point No Point Reach extends from the down-estuary river boundary (USACE Station 40+00) to approximately USACE Station 107+00 of the Lower Passaic River. The Reach follows a north-south trend and is the deepest portion of the Study Area. The only major natural inflow is Lawyer's Creek, a small drainage that enters from the left bank approximately 3,000 feet from the up-estuary end of the Reach. The Reach contains three bridges including the abandoned ConRail Bridge that delineates the lower portion of the Study Area, the Lincoln Highway, and the General Pulaski Skyway Bridges (U.S. Routes 1 & 9).

The USACE is responsible for delineating and maintaining navigation channels in the Passaic River. The Federal Project Limit was originally adopted in 1907 (modified in 1911, 1912, and 1930) to maintain a channel that is 30 feet deep (relative to mean low water (MLW)) and 300 feet wide in the Point No Point Reach (USEPA, 1995).

The last available USACE hydrographic survey was performed in 1989 to assess the conditions of the river. Water depths in the Point No Point Reach ranged from approximately 33.0 feet MLW at the down-estuary end to 21.1 feet MLW at the up-estuary end. The channel in the Point No Point Reach was last dredged in 1983 to the Project Depth of 30 feet. Previous dredging events in the period of interest are reported in 1940, 1946, 1957, 1965, and 1971 (IT 1986).

The shorelines of the Reach consist primarily of wooden and stone bulkheads and are bordered by several industrial facilities. The right shoreline contains several large industrial facilities including Western Electric, Badische Anilin- & Soda-Fabrik AG (BASF), SpectraServe and a former Monsanto manufacturing plant. The left shoreline consists of mostly wooden bulkheads and contains ship piers, several chemical and petrochemical manufacturing facilities (including Reichold Chemical, Sun Oil, Hoescht-Celanese), and the former Public Service Electric and Gas Company's (PSE&G) Essex

Generating Station. Combined sewer overflows (CSO) in this reach are depicted in Figure 1-2.

### ***Harrison Reach***

The Harrison Reach extends from approximately USACE Station 107+00 to USACE Station 221+00 of the Study Area. Frank's Creek enters the Reach from the right bank at approximately USACE Station 160+00. Based on the hydrographic survey conducted by USACE in 1989, water depths range from 21.1 feet MLW at the down-estuary end of the Reach to approximately 19.2 feet MLW at the up-estuary end. In general, areas of higher deposition are observed on the inside bend of the meanders rather than the outside bends.

Two bridges are located in the Harrison Reach and are positioned close together near the down-estuary end of the reach. Looking up-estuary, the first bridge is a ConRail (Penn Central) Freight Bridge and the second is the bridge for Interstate 95 (New Jersey Turnpike).

The USACE has delineated the Federal Project Limits for the Reach as a 300-foot wide channel with a Project Depth of 20 feet MLW. The only dredging event in the Harrison Reach within the period of interest was performed in 1949 with a Project Depth of 20 feet.

The right shoreline consists primarily of gravel rip-rap and wooden, or stone, bulkheads bordered by a passenger train yard and a train servicing depot. The left shoreline consists of wooden bulkheads bordered by several chemical facilities (*e.g.*, Benjamin Moore, Chemical Waste Management, Hilton-Davis, and Sherwin-Williams and inactive industrial properties (including Commercial Solvents and Diamond Shamrock). An abandoned marina is located at Blanchard Street between the abandoned Commercial Solvents site and the Benjamin Moore facility. CSOs in this reach are depicted in Figure 1-2.

### ***Newark Reach***

The Newark Reach extends from USACE Station 221+00 to USACE Station 298+00 of the Study Area and runs through the downtown section of the City of Newark. This Reach of the Passaic River begins in an east-west direction and slowly curves in a northerly direction.

The Newark Reach contains numerous bridges. Looking up-estuary the bridges include: Jackson Street Bridge, Amtrak Railroad Bridge, Harrison Avenue Bridge, ConRail Freight Railroad Bridge, William Stickel Memorial Bridge, and Clay Street Bridge, which delineates the up-estuary extent of the Newark Reach. The Center Street Bridge was previously located between the Amtrak and Harrison Avenue Bridges, however, this bridge has since been abandoned and the bridge piers removed.

The USACE has designated the Federal Project Limits as 300 feet wide in the Newark Reach with a Project Depth of 20 feet MLW. Dredging in this reach was performed in 1949 to a project depth of 16 feet MLW. The last hydrographic survey was performed in 1989 and showed that channel depths in the Reach range from 19.2 feet (MLW) at the down-estuary end to 18.7 feet (MLW) at the up-estuary end.

The right shoreline consists of wooden, metal, or stone bulkheads bordered by oil storage tanks and numerous small manufacturing facilities and a former coal burning facility near the Jackson Street Bridge. The left shoreline consists of parking lots and wooden, or stone, bulkheads bordered by a small park alongside Highway 52 (fenced on the river side). CSO in this reach are depicted in Figure 1-2.

### ***Kearny Reach***

The Kearny Reach extends from approximately USACE Station 298+00 to 350+00 in the Study Area. The Reach begins in a general north-south direction and then curves to the northeast. The Reach contains two bridges: the aforementioned Clay Street Bridge that delineates the boundary between the Newark and Kearny Reaches and a

former Erie & Lackawanna Railroad Bridge. The railroad bridge is abandoned and maintained in the open position.

The USACE has designated the Federal Project Limits for the Kearny Reach as 300 feet wide with a Project Depth of 20 feet MLW. Dredging in this reach was performed in 1949 to a project depth of 16 feet MLW. Based on the 1989 hydrographic survey, channel depths range from 18.7 feet MLW at the down-estuary end of the Reach to 17.0 feet MLW at the up-estuary end.

The left shoreline consists primarily of stone bulkheads and is bordered by train tracks serviced by ConRail and Highway 22 (McCarter Freeway) leading northward from downtown Newark. The ConRail train tracks end at the site of the former PPG manufacturing plant located along the left shore of Kearny Reach. The right shore of the Kearny Reach consists of wooden and stone bulkheads bordered by several small manufacturing facilities. CSOs in this reach are depicted in Figure 1-2.

### ***Upstream Reach***

The Upstream Reach extends from USACE Station 350+00 to the Dundee Dam. The river direction does not change appreciably in the Upstream Reach.

The USACE has delineated the Federal Project Limits as 200 feet wide in the Upstream Reach with a Project Depth of 16 feet MLW. Dredging in the navigable portion of this reach was performed in 1949 to a project depth of 16 feet MLW. Based on the 1989 hydrographic survey, the channel depth in the Reach is 17.0 feet MLW.

The right shoreline of the Upstream Reach consists of wooden and stone bulkheads bordered by several small manufacturing facilities and some private homes at the northern end of the Study Area. The left shore of the Upstream Reach consists primarily of parking lots. CSOs in this reach are depicted in Figures 1-2 and 1-3.

### 1.3 STUDY AREA HISTORY

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During the past two centuries, the Study Area has been subject to multiple influences and changes due to natural hydrological, topographical, climatological and ecological conditions. However, rapid expansion of urban and industrial centers in the region impacted the area significantly. Available information indicates that historical pollutant loadings throughout the 1900s had a substantial impact on the ecological conditions of the Study Area as well as the Newark Bay estuary (McCormick and Quinn 1975; Earll 1887; Mytelka *et al.* 1981; Esser 1982; Squires 1981; and Hurley 1992). Degradation of water quality in the Lower Passaic River, including the Study Area, first became apparent during the Civil War (Cunningham 1966b; Brydon 1974). In 1873, coal tar residues suspended in the river water were noted (Brydon 1974). The deteriorating water quality of the Lower Passaic River during this period forced many residents to dig their own wells. By 1885, however, a survey showed that 75% of groundwater wells also were polluted (Cunningham 1966b). Between 1884 and 1890, over 1,000 of the 1,500 wells in Newark were closed due to contamination (Galishoff 1988). In 1887, an inspector for the Passaic River declared that legal action would be required to mitigate pollution of the river from industrial waste practices (Brydon 1974).

The growing population of Newark during the first half of the twentieth century also resulted in increased volumes of human wastes, hence leading to the characterization of the Lower Passaic River as an open sewer (Suszkowski *et al.* 1990). Efforts to improve water quality and reduce the spread of disease led to the construction of a trunk sewer line system in 1924 (Brydon 1974). Despite the development of sewage treatment plants, many industrial facilities located along the Passaic River were not connected to the Passaic Valley Sewerage Commission (PVSC) trunk line until the late 1950s (Brydon 1974).

During the 1980s and early 1990s, several investigations were conducted to evaluate the concentrations of various potential contaminants in sediments within the



Study Area boundaries. These studies include investigations conducted as part of the RI work at the Diamond Alkali Superfund Study Area, investigations conducted on behalf of OCC in the early 1990s, and investigations conducted by various governmental agencies, including NOAA, USFWS, and USEPA. These investigations indicated that sediments of the Lower Passaic River contain elevated concentrations of numerous hazardous substances including, but not limited to, cadmium, copper, lead, mercury, nickel, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, 4,4'-dichlorodiphenyltrichloroethane (4,4'- DDT), diesel range organics, TEPH, polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, and chlorinated herbicides and phenols (Huntley, 1993; Bonnevie, 1993; Gillis, 1993; Wenning, 1993; Bonnevie, 1992; Bonnevie, 1994; Wenning, 1994).

#### **1.4 ECOLOGICAL RESOURCES**

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According to the RI/FS Work Plan (1995) submitted by OCC to the USEPA, the expansion of industry and population surrounding the Study Area has resulted in a severe reduction in the availability of natural habitats for indigenous and migratory biota (Squires and Barclay 1990). The majority of Newark occupies land that was once dominated by salt marsh. Now, this land is filled with more than 21 million tons of material, including industrial and municipal wastes, dredged material, and railroad cinders (Zdepski 1992). The left shore of the Study Area, just up-estuary of the New Jersey Turnpike Bridge was once primarily marshlands (ERM 1992). Between 1873 and 1890, this area was extensively filled with 8 to 12 feet of mixed fill material from coal gasification facilities, eliminating the marsh habitat and introducing a wide variety of chemicals to the environment (ERM 1992). By the early 1900s, the majority of salt marshes were filled with solid waste, and pesticide application was routine in an effort to eliminate mosquito-breeding areas (Zdepski 1992; Rod *et al.* 1989). A decline in bird diversity in the area is attributed to the destruction of marshlands and other natural habitats as a result of encroachment of human development and industrial activities on nesting and breeding grounds (Burger *et al.* 1993).

Populations of fish and shellfish in the Study Area and surrounding area have been substantially reduced by over-harvesting, loss of habitat, and pollution (Mytelka *et al.* 1981; Esser 1982; Franz 1982). A significant commercial fishery has not operated in Newark Bay or the Passaic River, including the Study Area, since the early 1900s (McCormick and Quinn 1975). As early as the Civil War, sales of oysters and shad were affected by reports that these organisms were tainted with coal oil and “off flavors” (Earll 1887; Squires 1981). The Commission of Fisheries of New Jersey reported in 1885 that water-borne pollution was resulting in declining fish populations in the Passaic River (Esser 1982). After the turn of the century, conditions apparently deteriorated rapidly until 1926 when a survey conducted in the area by the US War Department found “fish life destroyed” (Hurley 1992).

To limit public exposure to toxic contaminants in the Lower Passaic River, the State of New Jersey has introduced consumption advisories, closures, and sales bans. The initial measures prohibited the sale of fish and advised the public to avoid the consumption of several species of fish and eel based on the presence of PCB contamination in the seafood. The discovery of widespread dioxin contamination in the Newark Bay Complex led the State of New Jersey to issue a number of Administrative Orders in 1983 and 1984 that prohibited the sale, or consumption, of all fish, shellfish, and crustaceans from portions of the Passaic River, including the Lower Passaic River. These State advisories and prohibitions are still in effect today. (<http://www.state.nj.us/dep/dsr/pcb-dioxin-chart.htm>, last accessed April 28, 2004)

Further studies in the Lower Passaic River report the presence of some fish and benthos known to be highly tolerant of reduced dissolved oxygen (DO) conditions, implying the presence of a stressed aquatic system (Festa and Toth 1976; Santoro *et al.* 1980; Princeton Aqua Science 1982). Depressed levels of DO have been known to be a chronic problem in Newark Bay and its tributaries since the early 1900s (McCormick *et al.* 1983). Investigations conducted prior to 1940 by the Interstate Sanitation Commission indicated substantially decreased levels of DO throughout the region during the early part

of the century (ISC 1939). A survey of benthic organisms conducted in the Study Area in 1981 indicated that the benthic macro-invertebrate community was limited to those species capable of surviving extremely poor water quality conditions (Princeton Aqua Science 1982).

Available studies of sediment and water quality indicate that pollution control measures and the reduction, or control, of other environmental stressors have produced a gradual improvement in the ecosystem over the past two decades. Description of the ecological resources in Passaic River by NOAA (Zich 1978, USFWS 1980, Papson *et al.* 1981, RPI 1985) indicates that species such as blueback herring, alewives, American shad, striped bass, bay anchovy, mummichog, striped killifish, and white perch spawn within the Passaic River. Alewife, shad, and herring typically migrate upriver in the spring to spawn in less saline waters. Spawning in the Passaic occurs above the mouth of the Second River as well as in the Third and Saddle Rivers, but not in the Second River. Fish spawning habitat on the Passaic River is limited to below the Dundee Dam because of the absence of fish passage facilities. Furthermore, the tidal freshwater sections of the Passaic (from Dundee Dam to the mouth of the Second River) function as the principal nursery areas. Brackish water and marine species use the lower saline portions of the Passaic for adult and nursery habitat, depending on the salt wedge. Resident euryhaline species include white perch, mummichog, and striped killifish. These species spawn and develop within the estuary and are distributed throughout the system. Blue crabs use the lower brackish portion of the estuary as a nursery and adult habitat. The American eel uses the Passaic River and its tributaries for adult habitat. Recent surveys by TSI in 1999 through 2001 (TSI 2002) during the Ecological Sampling Plan field seasons recorded and collected twenty-four species of fish and crabs from the Lower Passaic River. These samples included estuarine, freshwater and marine species. Seven taxa of benthic invertebrates were also identified from the same stations. Approximately 30 bird species were also reported during the recent TSI survey (TSI 2002).

## **2.0 OBJECTIVES AND SCOPE OF EVALUATION**

### **2.1 OBJECTIVES**

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The primary goal of this section is to provide a preliminary evaluation of the historical sediment data available for the 17-mile tidal reach of the Lower Passaic River. Results of this evaluation will affect future RI/FS work by influencing field sampling and other activities in the Study Area. As mentioned previously, all the readily-available historical data was obtained electronically and is stored in the PREmis database. Because the historical data originated from various sources and was generated from various analytical methods and laboratories, the quality of the data was reviewed as part of the data quality scheme task. The objectives of the initial data quality review were to:

- Provide a preliminary quality review of the existing data in PREmis through a data quality scheme.
- Provide a preliminary review of the existing Passaic River sediment data to characterize the nature and extent of sediment contamination and identify a preliminary list of contaminants of potential concern (COPC).

### **2.2 SCOPE OF EVALUATION**

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This historical data evaluation was conducted to perform a preliminary evaluation of the electronically available historical sediment data to quickly determine the relevance of each sediment dataset in the PREmis database. Additional evaluation of the data may be required due to constraints on the scope of this task. The scope of this historical evaluation is defined on the next pages.

Scope	Recommendation(s), if any
<p>The data used in this evaluation were those that were readily available in an electronic format. Therefore, the Harbor Estuary Program (HEP)/Contaminant Assessment and Reduction Program (CARP) data, as well as the NJDEP data, were not used in this evaluation.</p>	<p>In order to produce a field sampling plan (FSP) that addresses the needs of all disciplines (<i>e.g.</i>, modelers, risk assessors, engineers), all of the data including surface water, biota, and sediment physical parameters, will eventually need to be reviewed and evaluated. Although the current database contains biota and sediment non-chemistry data, it is likely that the HEP/CARP and NJDEP data will fill some gaps in the biota and sediment sample locations. In addition, there are currently very few surface water samples in the database; however, water column samples were collected as part of CARP. When these data become available, they should be uploaded to PREmis, reviewed and incorporated into this evaluation.</p>
<p>This evaluation focused on sediment samples; surface water and biota samples were not included.</p>	
<p>The sediment samples were evaluated for chemical constituents only.</p>	<p>Non-chemistry data should also be reviewed and evaluated to obtain information on the sediment characteristics, transport mechanisms, <i>etc.</i></p>
<p>This evaluation focused on sediments within the 17-mile stretch of the Lower Passaic River from the Dundee Dam in Garfield, NJ to the mouth of the river.</p>	<p>The Lower Passaic River is part of the Newark Bay complex; an estuary that includes Newark Bay, the Lower Hackensack River (below the Oradell Dam) and its tributaries (<i>e.g.</i>, Berry's Creek, Pierson Creek), Arthur Kill, Kill van Kull, and the Lower Passaic River. Since the majority of the complex is tidally influenced, it is likely that sediment contamination in one part of the complex could influence sediment contaminant concentrations in another part of the complex. Therefore, additional information about the study area could be obtained through the evaluation of sediment contaminant concentrations in the other water bodies.</p>

Scope	Recommendation(s), if any
<p>The electronic data obtained for this evaluation were used without any significant corrections. For example, it is likely that some of the units for the data are incorrect (<i>e.g.</i>, metals data marked as parts per billion (ppb) that appear to be in parts per million (ppm) based on a comparison to the other data). In addition, a large amount of data was not used in the evaluation due to missing information (<i>e.g.</i>, coordinates).</p>	<p>For some of the data where potential anomalies are identified, the cost benefit of obtaining hard copies of the data and modifying the information in the PREmis database should be investigated.</p> <p>It is possible that some of the data not used in this evaluation could prove to be of significant value and could reduce the number of samples required to fill the data gaps. Therefore, the cost benefit of obtaining hard copies of some of the data and then modifying the information in the PREmis database should be investigated.</p>
<p>This analysis does not consider temporal variability in sediment concentrations. Therefore, it is assumed that the data are temporally invariant.</p>	<p>During the RI, samples will need to be collected to assess temporal changes in the data.</p>
<p>To determine the COPCs for this analysis, the data were compared to the NJDEP 1998 Marine/Estuarine Sediment Effects Range Median (ER-M), if applicable.</p>	<p>ER-M values were developed to assess the potential for the contamination to cause adverse effects on benthic organisms. However, the ER-M does not fully consider bioavailability of the contaminants in the sediment, or the potential to accumulate in higher-level organisms in the ecosystem. For instance, ER-Ms were developed based on sediments that had an organic carbon content of approximately 1%, and hydrophobic organic contaminants are typically less bioavailable in sediments with a higher organic carbon content than in sediments with low organic content. The equilibrium partitioning approach (DiToro <i>et al.</i>, 1991; EPA, 2003) is another method for assessing the potential for sediment contamination to cause harm to biota, and more thoroughly considers the release of contaminants from the sediments. Direct evaluations of measured biological tissue concentration can also help to determine the significance of the PCB concentrations in the area. Such an assessment of the bioavailability and bioaccumulation potential of the PCB was beyond the scope of this review.</p> <p>For risk assessment purposes, it may be more appropriate to select COPCs by comparing the data to the NJDEP ER-Ls. However, for the purposes of determining an initial list of COPCs, use of the ER-Ls results in an unmanageable number of COPCs. In the future, the risk assessors may want to use the ER-L to create an initial risk assessment COPC list. However, this list will ultimately need to be reduced to a number that can be efficiently modeled (estimated at approximately 20 contaminants).</p>

To determine the dioxin COPCs, the Canadian Sediment Quality Guidelines were used since there are no US-based guidelines ( <i>Protocol for the Derivation of Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment, 1995</i> ).	Standard sediment quality guidelines do not exist for dioxin/furan. It is recommended that a suitable approach to assess the relevance of the dioxin/furan sediment concentration be developed for the project. This may be based on an equilibrium partitioning approach in conjunction with bioaccumulation to key receptors, or some other applicable method.
The data were not reviewed to determine collection methods, use of the data, etc.	Because the data were collected under a variety of programs for a number of reasons, data used in the decision making process may need a further, more detailed review to determine their applicability in the sediment assessment process.
The chemical classes evaluated include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), dioxins/furans, and metals.	
The evaluation of the surficial sediments encompassed the entire 17-mile stretch of the Passaic River down-river of the Dundee Dam. The evaluation of the subsurface sediments encompassed the two miles of the Passaic River that appeared to contain the highest levels of contamination.	In order to identify data gaps in the subsurface sediment samples, an evaluation of all of the subsurface sediment data will need to be completed. This should include identifying the depth ranges that would be most useful to the different disciplines.
The historical data used in this evaluation were obtained from various data sources and uploaded into PREmis without any quality control checks (e.g., comparison of electronic data to hard copy data). In addition, no metadata are available for any of the historical information.	If the data show anomalous results, some proofing of the hard copy results to the electronic data may be required. In addition, some work may be needed to find any metadata that may exist.
Some of the historical data used in the evaluation have data qualifiers associated with them. Due to the lack of data dictionaries, it is unknown what the qualifiers mean. The only qualifier used for this evaluation is a "U", which was assumed to mean that the data are non-detect.	
When calculating the statistical results, only the detected values were considered. Statistical tests were limited to minimum, maximum and average.	Additional statistical tests (including, but not limited to, normal, lognormal, non-parametric and multivariate analysis) should also be run to obtain additional information about the spatial, temporal, and statistical distribution of contamination.

For the majority of the samples analyzed, the analytical methods are unknown. To determine whether the data were useable for this evaluation, the date of analysis was reviewed.	Analytical methods have significantly improved over the past decade. If the analytical method is unknown, it is possible that some of the PARCC (precision, accuracy, representativeness, completeness, and comparability) characteristics may not be sufficient for the data to be used (e.g., the detection limits are higher than the sediment guidelines). For data that are critical to this evaluation, the hard copy reports should be reviewed to determine if the analytical methods are acceptable.
Contouring and 3-dimensional analysis of the surface and subsurface sediment data have not been conducted.	<p>Surface sediment data should be contoured using suitable geographical information system (GIS) or other data analysis software, to better understand the relative magnitude of the surface sediment concentration distribution in the river.</p> <p>Surface and subsurface sediment data should be analyzed and visualized using three-dimensional geographical data analysis and presentation software, to better understand the magnitude of the subsurface sediment concentration distribution in the river. This may only be possible for certain parts of the river where there is sufficient density of subsurface data, and additional sampling is needed to fully characterize the subsurface contamination in key parts of the river.</p>
Much of the data reviewed for this exercise were generated 10 years ago, or more.	A subset of recent data should be compared to co-located data from the early- to mid-1990's, to understand the historical trends in the contamination. If insufficient recent data are available, then additional subsampling is needed to understand the contaminant situation today, and how it is changing.
For this evaluation, the samples were not compared to either background or reference samples.	During the RI appropriate background and reference samples will need to be collected for comparison to down-estuary samples.



### **3.0 AVAILABLE HISTORICAL DATA & DATA QUALITY SCHEME**

#### **3.1 AVAILABLE HISTORICAL DATA**

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The PREmis database contains over 300,000 available records of historic Passaic River data gathered from various federal agencies, state agencies, and private companies including: NOAA, NYCOE, NYSDEC, NYSDOH, USACE, USEPA, USFWS, TAMS, and TSI. The chemical and physical parameters contained in PREmis can be grouped into the following classes: conventional and geotechnical, radionuclide, metals, PAH, PCBs, pesticides/herbicides, dioxin/furan, semi-volatile organics, volatile organics, and total petroleum. Details of individual constituents of each group are given in Table 3-1.

The available data contain information for different media and sample types including: surficial sediment grabs (3,181 samples), composite sediment cores (91 samples), discrete sediment cores (1165 samples), sediment pore water (6 samples), bioaccumulation (1772 samples), biological tissue chemistry (721 samples), biota toxicity (71 samples) and water (353 samples). The tables below (Table 3-2 to Table 3-10) provide a distribution of the number of sample types per chemical/physical group for each data source.

**Table 3-2 Summary of the number of samples for each sample type/chemical group combination for TSI (Tierra Solutions Inc) data**

Chemical Group (TSI data)	Sample Type						
	Sediment				Water	Bioaccumulation	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core	Pore Water			
Dioxin/Furan	748	10	247	6			221
Metals (SEM)	762	10	250	6			221
PAH	760	10	234	6			221
PCB	790	10	248	6			222
Pesticides	757	10	248	6			221
Geotechnical	740	10	247	6			
Semi-Volatiles	760	10	248	6			221
Herbicides	668			5			208
Radionuclides	1132		561				13
Volatiles	657	10	79				
Total Petroleum	728	10	245				9

**Table 3-3. Summary of the number of samples for each sample type/chemical group combination for NOAA (National Oceanic and Atmospheric Administration) data**

Chemical Group (NOAA data)	Sample Type					
	Sediment			Water	Bioaccumulation	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
Dioxin/Furan	50					
Metals (SEM)	27					
PAH	26					
PCB	26					
Pesticides	26					
Geotechnical	27					
Semi-Volatiles	20					
Volatiles	20					

**Table 3-4. Summary of the number of samples for each sample type/chemical group combination for NYCOE (New York Corp of Engineers) data**

Chemical Group (NYCOE data)	Sample Type					
	Sediment			Water	Bioaccumula- tion	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
Dioxin/Furan			24			
Metals (SEM)			24			
PAH			31			
PCB			24			
Pesticides			24			
Geotechnical			65			

**Table 3-5. Summary of the number of samples for each sample type/chemical group combination for NYSDEC (New York State Department of Environmental Conservation) data**

Chemical Group (NYSDEC data)	Sample Type					
	Sediment			Water	Bioaccumula-tion	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
Dioxin/Furan						48
Metals (SEM)	10			1		232
PAH	15			1		11
PCB	10		31	1		373
Pesticides	10			1		280
Geotechnical	3		31			382
Semi-Volatiles	15			1		2
Volatiles	11			2		2

**Table 3-6. Summary of the number of samples for each sample type/chemical group combination for TAMS EarthTech, Inc data**

Chemical Group (TAMS data)	Sample Type					
	Sediment			Water	Bioaccumula- tion	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
PCB	48					
Geotechnical	44					

**Table 3-7. Summary of the number of samples for each sample type/chemical group combination for USACE (US Army Corp of Engineers) data (excludes unknown sample types from USACE-WES studies)**

Chemical Group (USACE data)	Sample Type					
	Sediment			Water	Bioaccumula-tion	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
Dioxin/Furan	33	52			443	
Metals (SEM)	30	23		231	1040	
PAH	29	15		12	583	
PCB	19	15		250	967	
Pesticides	19	15		248	898	
Geotechnical	548	3	226			
Semi-Volatiles						
Total Petroleum				108	343	

**Table 3-8. Summary of the number of samples for each sample type/chemical group combination for USEPA (US Environmental Protection Agency) data**

Chemical Group (USEPA data)	Sample Type					
	Sediment			Water	Bioaccumula-tion	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
Dioxin/Furan	37					
Metals (SEM)	154					
PAH	154					
PCB	484					
Pesticides	154					
Geotechnical	44					
Semi-Volatiles	154					
Volatiles	151					

**Table 3-9. Summary of the number of samples for each sample type/chemical group combination for NYSDOH (New York State Department of Health) data**

Chemical Group (NYSDOH)	Sample Type					
	Sediment			Water	Bioaccumula-tion	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
PCB	1					
Geotechnical	1					

**Table 3-10. Summary of the number of samples for each sample type/chemical group combination for FWS (US Fish & Wildlife Services) data**

Chemical Group (FWS data)	Sample Type					
	Sediment			Water	Bioaccumulation	Biological Tissue Chemistry
	Surface Grab	Composite Core	Discrete Core			
PCB						2

The information presented in Tables 3-2 to Table 3-10 illustrates the various historical data available in the PREmis database. In general, surface grab samples were obtained more frequently (total of 3,181 samples collected) than any other sample types. The only study in the PREmis database that analyzed porewater was the TSI sampling event (Table 3-2). Likewise, the available bioaccumulation data on PREmis are restricted to the USACE study (Table 3-7). This study includes data only for the following chemical groups: dioxin/furan, metals, PAH, PCB, pesticides, and total petroleum. Water sampling may present a significant data gap in the historical data with samples being collected in only two studies (Table 3-5, NYSDEC and Table 3-6, USACE). Historically, PCBs were more commonly tested in the individual studies while herbicides and radionuclides were rarely tested (Table 3-2).

### **3.2 DATA QUALITY SCHEME**

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As noted in Tables 3-2 to 3-10, a significant amount of historical data are available for the Passaic River Restoration Project Study Area. These data were collected by numerous entities (Table 3-11) for various uses; therefore, the quality of the data varies. A review of all the relevant, electronically-available, historical data collected for this project was conducted to establish its relevance to the site, and assign data quality flags based on this review.

**Table 3-11: Summary of Data Sources for the PREmis Database**

<b>DATA SOURCE</b>	<b>ORGANIZATION</b>	<b>PROJECT &amp; YEARS</b>
NOAA Query Manager	NOAA	NST Fish 1993, 1995, 1999
NYDEC Modified IT DB V.3	NOAA	NST Hudson-Raritan 1991, 1993
NYDEC Modified IT DB V.3	NYSDEC	Landfill Sources 1990-1998
NOAA Query Manager	NYSDEC	NYSDEC 1969-2001
NOAA Query Manager	NYSDOH	NYSDOH 1984-1985
NYDEC Modified IT DB V.3	TAMS EarthTech, Inc	Superfund - TAMS 1992-1993
BATTELLE	USACE	Dredged Material Testing 1993-1998
BATTELLE	NYCOE	NYNJ Harbor DMMP 1998
NYDEC Modified IT DB V.3	USEPA	EMAP 1990-1992
NYDEC Modified IT DB V.3	USEPA	REMAP 1993-1994
USEPA/TSI Passaic River Study Area DB V.3	USEPA & Tierra Solutions Inc (USEPA/TSI)	Superfund - PASSAIC 1990-2000
USEPA Modified TSI Passaic River Study Area DB V.4	USEPA & Tierra Solutions Inc (USEPA/TSI)	Superfund - PASSAIC 2001
NOAA Query Manager	USEPA	USEPA 1992-1994, 1998

To identify relevant data, the information in the PREmis database was parsed out according to location. Only studies containing data between the coordinates of 581,000 to 635,000 East and 655,800 to 773,300 North were included in this analysis - for a total of 58 relevant studies. (Refer to Figure 3-1 for a map showing the coordinate boundaries.) Table 3-12 below lists these 58 relevant studies including their study name, PREmis identification number, and organization that sponsored the study.

**Table 3-12: Study with corresponding organization/program that contains relevant data to the Passaic River Study Area**

<b>PREmis Study ID</b>	<b>Organization/Program</b>	<b>Study Name</b>
465	NST	NOAA NS&T Hudson-Raritan Phase I, 1991
466	NST	NOAA NS&T Hudson-Raritan Phase II, 1993
471	NYSDEC	NYSDEC 1975
472	NYSDEC	NYSDEC 1980
473	NYSDEC	NYSDEC 1983
474	NYSDEC	NYSDEC 1984
475	NYSDEC	NYSDEC 1985
476	NYSDEC	NYSDEC 1987
477	NYSDEC	NYSDEC 1990
478	NYSDEC	NYSDEC 1993
479	NYSDEC	NYSDEC 1994
480	NYSDEC	NYSDEC 1995
481	NYSDEC	NYSDEC 1997
482	NYSDEC	NYSDEC 1998
483	Superfund - TAMS	TAMS Hudson River Database, HR-002
484	Superfund - TAMS	TAMS Hudson River Database, HR-003
485	Superfund – TAMS	TAMS Hudson River Database, HR-004
486	Superfund – TAMS	TAMS Hudson River Database, HR-006
462	USEPA	EPA EMAP 90-92
463	USEPA	REMAP, 1993
464	USEPA	REMAP, 1994
97	Dredged Material Testing	PASSAIC 1990 Surficial Sediment Investigation
98	Dredged Material Testing	PASSAIC 1991 Core Sediment Investigation
99	Dredged Material Testing	PASSAIC 1992 Core Sediment Investigation
100	Dredged Material Testing	PASSAIC 1993 Core Sediment Investigation - 01 (March)
104	Dredged Material Testing	PASSAIC 1993 Core Sediment Investigation - 02 (July)
106	Dredged Material Testing	PASSAIC 1993 USEPA Surficial Sediment Program
107	Dredged Material Testing	PASSAIC 1994 USEPA Surficial Sediment Program
119	Dredged Material Testing	PASSAIC 1995 Biological Sampling Program
120	Dredged Material Testing	PASSAIC 1995 RI Sampling Program
121	Dredged Material Testing	PASSAIC 1995 Sediment Grab Sampling Program
122	Dredged Material Testing	PASSAIC 1995 USACE Minish Park Investigation
144	Dredged Material Testing	PASSAIC 1996 Newark Bay Reach A Sediment Sampling Program
146	Dredged Material Testing	PASSAIC 1997 Newark Bay Reach B, C, D Sampling Program
147	Dredged Material Testing	PASSAIC 1997 Outfall Sampling Program
148	Dredged Material Testing	PASSAIC 1998 Newark Bay Elizabeth Channel Sampling Program
149	Dredged Material Testing	PASSAIC 1999/2000 Minish Park Monitoring Program
530	Superfund - Passaic	PASSAIC 1999 Late Summer/Early Fall ESP Sampling Program

<b>PREmis Study ID</b>	<b>Organization/Program</b>	<b>Study Name</b>
465	NST	NOAA NS&T Hudson-Raritan Phase I, 1991
466	NST	NOAA NS&T Hudson-Raritan Phase II, 1993
471	NYSDEC	NYSDEC 1975
472	NYSDEC	NYSDEC 1980
473	NYSDEC	NYSDEC 1983
474	NYSDEC	NYSDEC 1984
475	NYSDEC	NYSDEC 1985
476	NYSDEC	NYSDEC 1987
477	NYSDEC	NYSDEC 1990
478	NYSDEC	NYSDEC 1993
479	NYSDEC	NYSDEC 1994
531	Superfund - Passaic	PASSAIC 1999 Newark Bay Reach ABCD Baseline Sampling Program
532	Superfund - Passaic	PASSAIC 1999 Sediment Sampling Program
533	Superfund - Passaic	PASSAIC 2000 Spring ESP Sampling Program
534	Superfund - Passaic	PASSAIC 2001 Supplemental ESP Biota Sampling Program
535	Superfund - Passaic	93F62MT: MOTBY (MILITARY OCEAN TERMINAL AT BAYONNE)
536	Superfund - Passaic	93F64CL: CLAREMONT 93 REACH III (93FCLMT)
537	Superfund - Passaic	93F64HR: HACKENSACK RIVER
538	Superfund - Passaic	93F64PE: PORT ELIZABETH 93
539	Superfund - Passaic	94F36BU: BUTTERMILK
540	Superfund - Passaic	94F41HU: HUDSON RIVER
541	Superfund - Passaic	94F62LI: LIBERTY ISLAND
542	Superfund - Passaic	95F34BR: BAY RIDGE
543	Superfund - Passaic	95F34RH: RED HOOK
544	Superfund - Passaic	95F64CL: CLAREMONT RETEST
545	Superfund - Passaic	95F64PJ: PORT JERSEY
546	Superfund - Passaic	96PEXXON: EXXON
547	Superfund - Passaic	96PNBCDF: NEWARK BAY CONFINED DISPOSAL FACILITY
548	Superfund - Passaic	96PPANYNJ: PORT AUTHORITY NEW YORK NEW JERSEY
550	Superfund - Passaic	97F62RH: ACOE RED HOOK FLATS
551	Superfund - Passaic	97F62RH RE: COE RED HOOK FLATS RETEST

Notes:

NST-National Status and Trends

Superfund Passaic – Diamond Alkali’s Superfund Data



### 3.3 ESTABLISHING APPROPRIATE DATA QUALITY SCHEME

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A list of attributes (data quality factors) that are the most useful in establishing data quality was compiled into a checklist. The relevant studies were then assigned values for each data quality factor. The following list of data quality factors are examples of the questions that were asked during the data screening evaluation. A comprehensive list of all 45 screening items is provided in Table 3-13 (below).

Is the Study Year Available – This question is important since older data may have higher method detection limits (MDLs) than newer data. For analytes that are typically present at trace levels, previous non-detect data may show detections when the MDL is lower.

- What Program Analyzed the Data– The USEPA Contract Laboratory Program (CLP) has established quality and MDL requirements. Data analyzed through the CLP are considered to be the highest quality data.
- Are Reference Coordinates or Area Coordinates Available – Data that cannot be accurately located on a map are not considered as useful as data that can be located according to their coordinates.
- Are Sample Coordinates Available – Data that cannot be accurately located on a map are not considered as useful as data that can be located according to their coordinates.
- Were Field Quality Control (QC) Samples Collected – Field QC samples can be used to determine if the field sampling and/or shipping introduced any bias into the data results.
- Were Laboratory QC Samples Collected – Laboratory QC samples can be used to determine if the laboratory analysis introduced any bias into the data results.
- Are Sample Collection Dates Available – Some of the analyte concentrations vary depending on time of year (e.g., biological activity, salinity). Therefore, the data are more useful if the sample dates are known.
- Are Sample Collection Depths Available – To understand the data, the depth the sample was collected at is very important (e.g., surface water flow direction and salinity could vary due to depth in the water column).

- Are the Media and/or Species Identified - If the media or species are unknown, the data are of extremely limited use.
- Are Units Given for the Data Results – Without units, the data is not useful.
- Are Laboratory Qualifiers Given – For certain sampling programs, consistent laboratory qualifiers are used to identify QC problems with the data. For example, an asterisk may indicate a sample that had surrogate spike results outside of the QC limits.
- Is the Detection Limit Given – If data is marked non-detect and a detection limit (DL) is not given, the data are of extremely limited use. For example, the Applicable or Relevant and Appropriate Requirement (ARAR) may be 10 micrograms per liter (µg/L) while the DL is 200 µg/L.
- Are the Analytical Method and/or Extraction Method Given – This information can be used to determine the quality of the data. For example, certain analytical methods are more accurate than others (e.g., Gas Chromatography versus Gas Chromatography/Mass Spectrometry). In addition, some methods have set DLs.
- Is the Sample Weight/Volume Given – This information can be used to determine if sufficient sample volume was used to achieve a low DL.
- Is the Percent Moisture or Percent Lipids Given – This information is used to get information about the quality of the data. For example, analyte concentrations for sediment samples with high moisture contents are typically biased high.
- Was the Sample Diluted – This information can be used to determine if analytes with low concentrations were diluted out of the sample or if the chromatograms show a lot of interference. For example, samples with high hydrocarbon concentrations may have “hydrocarbon bumps” in the chromatogram that obscure the presence of other compounds.
- Were the Data Validated – Validated data are considered higher quality data than unvalidated data.

**Table 3-13: Comprehensive List of All Screening Items**

<b>General Information</b>														
<i>Screening Item No.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>
	<b>Study Number</b>	<b>Data Quality Level</b>	Program	Study ID	Study Name	Organization	Study Year	File name	Study Start Date or Min sample collection date	Study End Date or Max sample collection date	Test type	List distinct media reported	List distinct chemical class reported	Is Program CLP Level Program

FIELD DATA												
15	16	17	18	19	20	21	22	23	24	25	26	27
Reference or Area Lat/Lon Location Data	Sample Lat/Lon Location Data	Sample X/Y Coordinates (Northings/ Eastings)	Collection Start Date	Collection End Date	Field QC samples	Collection depth top	Collection depth bottom	Collection depth units	Field Sample size	Field Sample size units	Media	Species

<b>ANALYTICAL DATA</b>															
<i>28</i>	<i>29</i>	<i>30</i>	<i>31</i>	<i>32</i>	<i>33</i>	<i>34</i>	<i>35</i>	<i>36</i>	<i>37</i>	<i>38</i>	<i>39</i>	<i>40</i>	<i>41</i>	<i>42</i>	<i>43</i>
Units	Lab Qualifiers	Final Qualifiers	Detect limit	Analytical QC Samples	Analysis Methods	Lab Name	Extraction Method	Extraction Dates	Sample wt/volume	Sample wt/volume units	Percent Moisture	Percent lipids	Analysis Dates	Validation level	Dilution

<b>OTHER INFORMATION</b>	
44	45
Login(s)	Record Count

### 3.4 DATA QUALITY LEVELS

Four Data Quality Levels (Table 3-14) were created based on the presence or absence of the data quality factors detailed in Table 3-13 as well as the robustness and usability of the data. The four quality levels are:

- Level 1A High Quality – CLP;
- Level 1B High Quality – non CLP;
- Level 2 Medium Quality; and
- Level 3 Lowest Quality.

**Table 3-14: Data Quality Scheme Screening Matrix**

		<b>Data Quality Level 1A (High Quality - CLP)</b>	<b>Data Quality Level 1B (High Quality - Non CLP)</b>	<b>Data Quality Level 2 (Medium Quality)</b>	<b>Data Quality Level 3 (Lowest Quality)</b>
<i>Screening Item No.</i>	<b>GENERAL INFORMATION</b>				
14	Is Program a CLP or GLP Level Program?	<b>X</b>			
	<b>FIELD DATA</b>				
15,16,17	Location Data	<b>X</b>	<b>X</b>	<b>X</b>	
18	Start Date	<b>X</b>	<b>X</b>	<b>X</b>	
19	End Date	<b>X</b>	<b>X</b>	<b>X</b>	
20	Field QC samples	<b>X</b>	<b>X</b>		
21	Collection depth top	<b>X</b>	<b>X</b>		
22	Collection depth bottom	<b>X</b>	<b>X</b>		
23	Collection depth units	<b>X</b>	<b>X</b>		
24	Field Sample size				
25	Field Sample size units				
26	Media	<b>X</b>	<b>X</b>	<b>X</b>	
27	Species	<b>X</b>	<b>X</b>	<b>X</b>	

		<b>Data Quality Level 1A (High Quality - CLP)</b>	<b>Data Quality Level 1B (High Quality - Non CLP)</b>	<b>Data Quality Level 2 (Medium Quality)</b>	<b>Data Quality Level 3 (Lowest Quality)</b>
	<b>ANALYTICAL DATA</b>				
28	Units	X	X	X	X
29	Lab Qualifiers	X	X	X	X
30	Final Qualifiers	X			
31	Detection limit	X	X	X	
32	Analytical QC Samples	X	X		
33	Analysis Methods	X	X		
34	Laboratory	X	X		
35	Extraction Method	X	X		
36	Extraction Dates	X	X		
37	Sample weight/volume	X	X		
38	Sample weight/volume units	X	X		
39	Percent Moisture	X	X		
40	Percent lipids	X	X		
41	Analysis Dates	X	X		
42	Validation level	X			
43	Dilution	X	X	X	

### 3.5 SCREENING PROCESS

The screening review consisted of extracting the applicable information for each of the 58 relevant studies from PREmis and using the output to answer questions posed by the data quality factor checklist. Based on the script and query outputs, the electronic checklist was populated for each study.

The following is a summary of the database rules used during the data screening. In these rules, the query numbers can be found in Table 3-13, and the letter *N* stands for the word No whereas the letter *Y* stands for Yes (see attachment). Note that all nulls were reported as *N* in the checklist.

- Query 12. If the media were mixed (*e.g.*, tissue and sediment) within a study, then the record counts were included in the checklist to show proportion of media reported.
- Query 14. If program was not CLP, then an N was used in the checklist.
- Queries 15, 16, and 17. If the location coordinates or Latitude/Longitude (Lat/Long) were reported as 999999 (*i.e.*, the coordinates are not available), then an N was used in the checklist.
- Queries 18 and 19. If the start and end dates were not reported, then an N was used in the checklist. Note that only the start date was used in evaluating the data quality.
- Queries 20 and 32. If Field QC and Lab QC were reported as only SA, REG, UNK (unknown), AVG (average), TEST, LAB\_SA, or REF (reference), then QC samples were assumed not reported and an N was used in the checklist
- Queries 21, 22 and 23. If all sample collection top and bottom depths were reported as 0, then an N was used on the checklist. If collection bottom depth were reported as 0, null, or a value, then a Yes/No (Y/N) was used in the checklist. If collection depth units were reported as 0, null, or a value, then a Y/N was used in the checklist.
- Query 26. If media is unknown or null, then an N was used in the checklist.
- Queries 24 and 37. If field sample size or sample size is 0, then an N was used in the checklist.
- Query 29. If at least one laboratory qualifier was reported, then a Y was used in the checklist.
- Query 30. Since none of the data in the relevant studies have final qualifiers, then an N was used in the checklist for all studies.
- Query 31. If detection limits for non-detect results were reported, or if all samples in a study had positive detections, then a Y was used in the checklist.

- Query 33. The Analysis Methods were not always valid analysis methods; instead they were mostly reported as analysis types or chemical class (*e.g.*, PCB, VOLATILES). If Analysis Method was reported as a chemical class, or as UNKNOWN, an N was used in the checklist. If the Analysis Method was reported as a known analytical method (*e.g.*, GFAA, ICP-MS, PAH\_SIM), then a Y was reported in the checklist.
- Query 40. For six studies, the percent lipid value was reported as a placeholder of -9 for at least some of the data records. For these data, an N was used in the checklist because the data values are not real values. This substitution only applies to biological samples.
- Query 43. Dilutions that were reported as 1 for all records were reported as Y on the checklist. However, because the reported data is historic, it cannot be certain whether these reported dilutions are actual dilutions or default values. To verify the reported dilutions the original data source must be reviewed.
- Query 44. The Login ID is a tracking field used by Battelle (Oracle) and is not used in PREmis. The ID is used to refer back to the original data if questions arise. The ID is selected from the Study Table (in some cases different from the Results table)

### 3.6 SUMMARY OF DATA QUALITY

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In summary, the data screening revealed that all 58 relevant studies fell into Data Quality Level 2 (medium quality) because analysis methods and analytical QC information were unavailable for all of the studies. (Refer to Attachment 1 for a summary of the checklist and the assigned data quality levels.) Since the objective of this task was only to screen the data, the screening checklist (items #15 to #43) was a compilation of simple Yes-or-No questions. Occasionally, the query resulted in a Y response for some records and an N response for other records within the same study. For these results, a Y/N was entered in the checklist. As a conservative measure, an N was used to determine the data quality level, and an asterisk was included on the data checklist with a footnote to show that the data were reported for some records. It should be noted that only electronic data was reviewed for this task. It is possible that once hard copy data reports (if available) are reviewed some of the data will be switched to a higher

data level. In these cases, the database should also be updated to include data for the applicable fields



## 4.0 PRELIMINARY EVALUATION

### 4.1 PRELIMINARY EVALUATION METHODOLOGY

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This section presents the results of the historical sediment data evaluation, based on the chemical data from the 58 relevant studies outlined in Section 3. The methodology used to complete this evaluation is as follows:

- Since the Lower Passaic River is an estuary (and does not have one-directional flow), the terms up-estuary and down-estuary were used to represent direction in the waterbody. Up-estuary was used when moving toward the freshwater section and down-estuary was used when moving toward Newark Bay.
- Sediment data were divided into surface sediment (less than 0.5 feet depth) and subsurface sediment (below 0.5 feet depth).
- Statistical analysis of chemicals in surface and subsurface sediments, describing the frequency of detection, the frequency of exceedance above applicable screening values, minimum, maximum and mean concentrations, were performed.
- Sediment concentrations in surface and, if applicable, subsurface sediment were screened against established sediment quality guidelines (SQGs) to determine the exceedance frequency of chemicals. Information on the frequency of exceedance and the frequency of detection were used to determine a preliminary list of COPCs. In general, the Long *et al.* (1995) marine/estuarine ER-M screens, which represent a greater than 50% incidence of adverse effects to sensitive species and/or life stages, were selected for screening chemical data. General guidelines of 50% detection frequency where no SQG was given or 25% exceedance frequency when SQG were available, were used to determine COPCs. Note that if a chemical group as defined by the SQG is classified as a COPC, then the individual chemical constituents of the chemical group were assumed to be COPCs (*e.g.*, total PCBs). For chemicals for which SQGs were not available, the determination of whether they are COPCs was based on the overall frequency of sample detection. Note that these are general guidelines. Class specific criteria were also used (*e.g.*, since metals are naturally occurring they are ubiquitous in the environment. Therefore, additional information, such as spatial distribution, was also used in the screening), where applicable. Refer to each class section below for additional information.

- Because some SQGs are available for chemical groups (*e.g.*, Total PCBs), the total concentration of the SQG chemical group was determined by summing the individual constituent concentration with the assumption of zero concentration for non-detected values.
- The spatial extent (areal and depth) of contamination for COPCs are presented in point maps. Surface sediment maps are presented for the entire 17-mile stretch of the river. Subsurface maps, which were restricted to hot spots, present the following depth ranges; 0.5 to 1 foot, 1 to 3 feet, 3 to 6 feet, and > 6 feet.
- Depth units for sediment cores were assumed to be in feet where no depth information was provided. The bottom depth value was used to map subsurface concentrations.

## 4.2 METALS

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### 4.2.1 Preliminary Screening of Database for Metals COPCs

At the time of this evaluation, PREmis contained 11 different studies for which samples were collected and analyzed for metals. Altogether, the database consisted of 378 surficial sediment samples (defined as those samples collected within the top 6 inches) and 643 subsurface sediment samples. A list of all the metals analyzed for is contained in Table 4-1. Not all samples were analyzed for all parameters. For this initial screening, the metals were subdivided into two subclasses; RCRA Metals and non-RCRA Metals.

The sediment guidelines used for this evaluation were the 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines (Long *et al.*, 1995) ER-M. Within the ER-M data there were guidance values available for nine metals. All of the parameters listed in Table 4-1 were evaluated based how many samples exceeded the ER-M, or if applicable, the ER-L values. If 25% of the samples analyzed for a specific parameter exceeded the guidance levels, the metal was considered a COPC. For the remaining metals that did not have guidance values, the contaminant was considered a COPC based on several evaluation criteria including, among others, frequency of detection and spatial distribution. Since metals are naturally occurring in the environment, the typical

detection frequency of 50% could not be used for this evaluation (<http://www.mii.org/commonminerals.html>, last accessed May 3, 2004).

**Table 4-1 – Metals Listed in PREmis Database**

<b>CAS Number</b>	<b>Chemical</b>	<b>1998 NJDEP Marine/Estuarine Sediment Screening Guidelines (Long et al., 1995) ER-M(ppb)</b>
BBL-AVS	Acid Volatile Sulfide (Historical)	--
7429-90-5	ALUMINUM	--
7440-39-3	BARIUM	--
7440-41-7	BERYLLIUM	--
7440-48-4	COBALT	--
7440-50-8	Copper	2.70E+05
7439-92-1	Lead	2.18E+05
7440-02-0	Nickel	5.16E+04
7440-09-7	POTASSIUM	--
7782-49-2	SELENIUM	--
7440-22-4	Silver	3.70E+03
7440-36-0	ANTIMONY	2.50E+04
7440-38-2	Arsenic	7.00E+04
7440-43-9	Cadmium	9.60E+03
7440-70-2	CALCIUM	--
7440-47-3	Chromium	3.70E+05
57-12-5	CYANIDE	--
7439-89-6	IRON	--
7439-95-4	MAGNESIUM	--
7439-96-5	MANGANESE	--
7439-97-6	Mercury	7.10E+02
7440-21-3	SILICON	--
7440-23-5	SODIUM	--
7440-28-0	Thallium	--
7440-31-5	TIN	--
7440-32-6	Titanium	--
7440-62-2	VANADIUM	--
7440-66-6	Zinc	4.10E+05

#### **4.2.2 Summary of Metals Contamination**

Overall, three of the eight RCRA metals, lead, mercury, and silver, were found at elevated concentrations in the surface and subsurface sediments collected within the 17-

mile tidal reach of the Passaic River Restoration Project Study Area and are considered COPCs. For the non-RCRA metals, 13 out of 19 were found within the 17-mile tidal reach of the Passaic River Restoration Project Study Area; however, only two metals, cobalt and zinc, are considered to be COPCs. The other metals were not included as COPCs based on several evaluation factors.

A total of five metal COPCs were identified. The following COPCs will be analyzed in detailed statistical and action level reports:

- Lead
- Mercury
- Silver
- Cobalt
- Zinc

#### **4.2.3 Statistical Analysis**

##### **4.2.3.1 RCRA Metals**

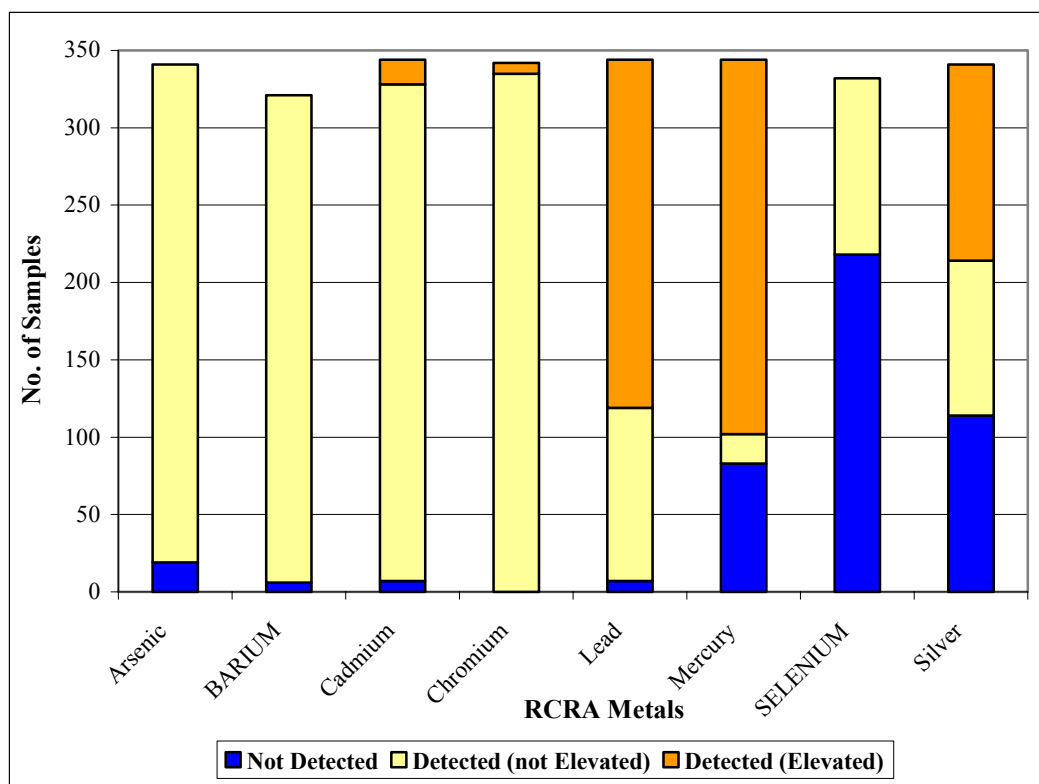
Overall statistical analyses for the RCRA metals for the entire Lower Passaic River are presented in Table 4-2 and Figure 4-1. The following general observations can be made from the statistical analysis. Lead, mercury and silver are analyzed in detail later in the report.

- As shown in Figure 4-1, since more than 25% of the samples analyzed for lead, mercury and silver exceeded the 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines ER-M criteria; they were considered a COPC.
- Maximum concentrations for all RCRA metals except selenium were detected in the Upstream Reach.

- 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines ER-M criteria for barium and selenium are not available. Although barium was detected in more than 50% of the total samples, it was eliminated from the COPC list. Barium was detected in almost all of the samples collected in all reaches with an average concentration of 127 ppm. The maximum and minimum concentrations of Barium are 0.000191 and 1280 ppm respectively. Barium is a naturally-occurring mineral found in the environment and it is commonly mined from layers of sedimentary rock. (<http://www.mii.org/commonminerals.html>, last accessed May 3, 2004 and <http://www.epa.gov/region5/superfund/ecology/html/toxprofiles.htm#ba>, last accessed May 3, 2004).
- Selenium was detected in less than 50% of total samples, and therefore it was not considered as COPC. The maximum concentration of 38.1 ppm for Selenium was detected in the Point No Point Reach.
- In all the samples arsenic was detected below the ER-M guidance values in all reaches with an average concentration of 8.38 ppm. Cadmium and chromium were detected above the sediment guidance values in 10% and 4% of the samples, respectively. The average concentrations of cadmium and chromium were 4.15 and 113.1 ppm, respectively.

**Table 4-2 – Statistical Report for RCRA Metals**

CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Criteria Value(ppb)	Exceedance Frequency
7440-38-2	Arsenic	8.50E-03		6.74E+04		NG/G	8.39E+03	Upstream Reach	322 / 341	7.00E+04	-- / 341
7440-39-3	BARIUM	1.91E-01		1.28E+06		NG/G	1.27E+05	Upstream Reach	315 / 321	--	-- / 321
7440-43-9	Cadmium	5.76E-03		2.90E+04		NG/G	4.15E+03	Upstream Reach	337 / 344	9.60E+03	16 / 344
7440-47-3	Chromium	3.31E-01		8.60E+05		NG/G	1.13E+05	Upstream Reach	342 / 342	3.70E+05	7 / 342
7439-92-1	Lead	3.00E-01		2.20E+06		NG/G	2.52E+05	Upstream Reach	337 / 344	2.18E+05	225 / 344
7439-97-6	Mercury	5.40E-05		1.24E+04		NG/G	3.03E+03	Upstream Reach	261 / 344	7.10E+02	242 / 344
7782-49-2	SELENIUM	3.90E-03		3.81E+04		NG/G	2.06E+03	Point No Point Reach	114 / 332	--	-- / 332
7440-22-4	Silver	1.90E-03		3.95E+04		NG/G	4.54E+03	Upstream Reach	227 / 341	3.70E+03	127 / 341



**Figure 4-1 – Statistical Data Evaluation of RCRA Metals**

#### 4.2.3.2 Non-RCRA Metals

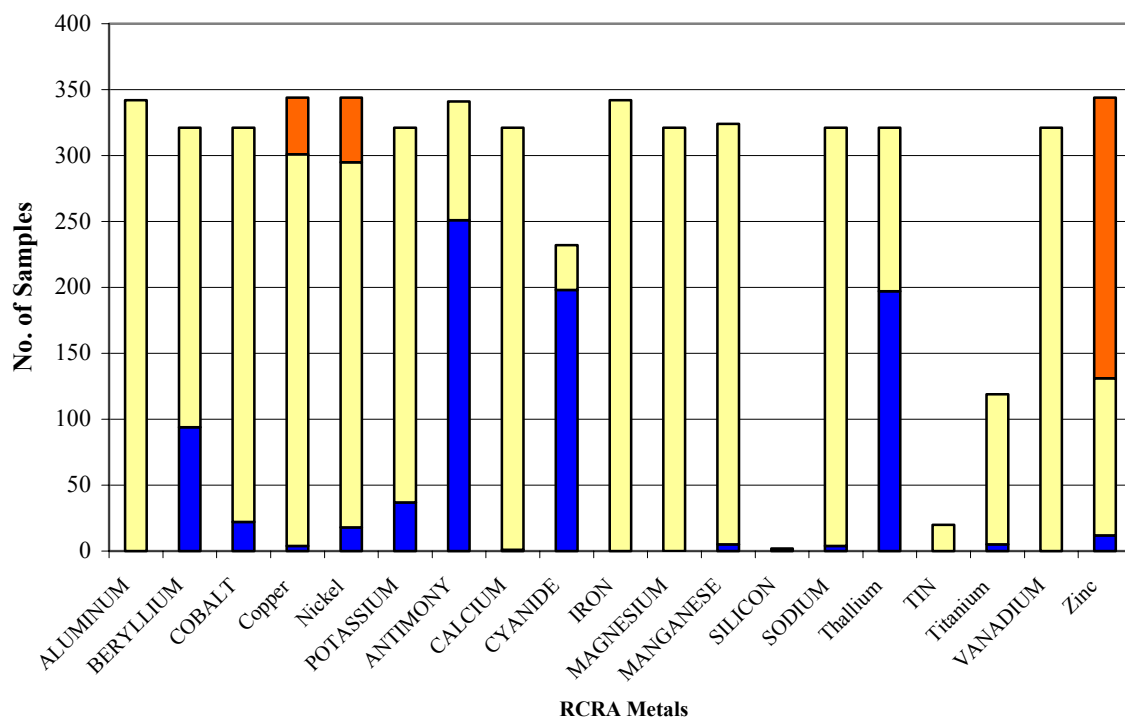
For the non-RCA metals, ER-M guidance values were only available for copper, nickel and zinc. The database was queried and the compounds were pulled into a statistical report to examine detection frequencies. Figure 4-2 shows the statistical results for the surficial sediment non-RCRA metals data. As shown in Figure 4-2, more than 25% of the samples analyzed for zinc exceeded the ER-M guidance values. Among the remaining metals that did not have comparison values, cobalt was considered a COPC since it was detected in more than 50% of the samples.

Overall statistical analysis for the non-RCA metals is presented in Table 4-3. The following general observations can be made from this table.

- Aluminum, calcium, iron, magnesium, silicon, manganese, sodium, tin, and vanadium were detected in nearly all of the samples collected in all reaches. Metals such as aluminum, iron, silicon, manganese, sodium, tin, and vanadium are commonly available minerals in the environment. Therefore, these metals were not considered as the COPC. The maximum, minimum and average concentrations for these metals are presented in Table 4-3.
- In the five reaches evaluated, potassium was detected in 70% to 92% of the samples collected. The average concentration for all of the reaches was 1511 ppm. The sample with the maximum concentration (5860 ppm) was detected in the Point No Point Reach.
- In the five reaches evaluated, titanium was detected in 60% to 100% of the samples collected. The average concentration for all the reaches was 408 ppm. The sample with the maximum concentration (732) ppm was detected in the Newark Reach.
- In the five reaches evaluated, beryllium was detected in 48% to 100% of the samples collected. The average concentration for all the reaches was 0.6 ppm. The sample with the maximum concentration (3.1 ppm) was detected in the Harrison Reach.
- Antimony, cyanide and thallium were detected in less than 50% of the total samples collected in all reaches. Therefore, these contaminants were not considered COPCs. The maximum, minimum and average concentrations for these contaminants are presented in Table 4-3.
- Less than 25% of the samples analyzed for copper and nickel exceeded the ER-M guidance values. Therefore, they were not considered as COPCs. The maximum concentrations of copper (2,470 ppm) and nickel (369 ppm) were detected in the Newark Reach.

**Table 4-3 – Statistical Report for Non-RCRA Metals**

CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Criteria Value(ppb)	Exceedance Frequency
7429-90-5	ALUMINUM	3.70E+01		6.51E+07		NG/G	1.16E+07	Point No Point Reach	342 / 342	--	-- / 342
7440-41-7	BERYLLIUM	1.34E-02		3.10E+03		NG/G	6.04E+02	Harrison Reach	227 / 321	--	-- / 321
7440-48-4	COBALT	1.92E-02		4.11E+04		NG/G	8.94E+03	Harrison Reach	299 / 321	--	-- / 321
7440-50-8	Copper	1.23E-02		2.47E+06		NG/G	1.65E+05	Newark Reach	340 / 344	2.70E+05	43 / 344
7440-02-0	Nickel	6.80E-02		3.69E+05		NG/G	3.62E+04	Newark Reach	326 / 344	5.20E+04	49 / 344
7440-09-7	POTASSIUM	7.00E+00	NJH	5.86E+06	NJH	NG/G	1.51E+06	Point No Point Reach	284 / 321	--	-- / 321
7440-36-0	ANTIMONY	1.70E-03		4.39E+04		NG/G	2.09E+03	Upstream Reach	90 / 341	--	-- / 341
7440-70-2	CALCIUM	5.90E+01	M	3.65E+07	M	NG/G	4.77E+06	Newark Reach	320 / 321	--	-- / 321
57-12-5	CYANIDE	2.40E+02		2.69E+05		NG/G	1.03E+04	Harrison Reach	34 / 232	--	-- / 232
7439-89-6	IRON	4.80E+01		4.39E+07		NG/G	2.08E+07	Harrison Reach	342 / 342	--	-- / 342
7439-95-4	MAGNESIUM	5.20E+01		1.11E+07		NG/G	4.57E+06	Point No Point Reach	321 / 321	--	-- / 321
7439-96-5	MANGANESE	2.00E+00		8.75E+05		NG/G	3.27E+05	Harrison Reach	319 / 324	--	-- / 324
7440-21-3	SILICON	3.17E+08		3.71E+08		NG/G	3.44E+08	Newark Reach	2 / 2	--	-- / 2
7440-23-5	SODIUM	2.90E+01		1.48E+07		NG/G	3.71E+06	Harrison Reach	317 / 321	--	-- / 321
7440-28-0	Thallium	1.70E-03	M	4.90E+03	M	NG/G	1.08E+03	Newark Reach	124 / 321	--	-- / 321
7440-31-5	TIN	5.70E+02		8.29E+04		NG/G	3.82E+04	Harrison Reach	20 / 20	--	-- / 20
7440-32-6	Titanium	1.41E+05	N*JL	7.35E+05	N*JL	NG/G	4.08E+05	Newark Reach	114 / 119	--	-- / 119
7440-62-2	VANADIUM	7.90E-02	M	9.88E+04	M	NG/G	3.04E+04	Harrison Reach	321 / 321	--	-- / 321
7440-66-6	Zinc	2.00E+00		1.90E+06		NG/G	4.25E+05	Upstream Reach	332 / 344	4.10E+05	213 / 344



**Figure 4-2 – Statistical Data Evaluation of Non-RCRA Metals**



#### **4.2.4 Detailed Evaluation of COPCs**

The five COPCs from above were analyzed in a detailed evaluation through mapping surface and subsurface data points in the river. From these analyses the extent of contamination will be discussed and any data gaps that exist will be considered for future sampling events. Note that all of the samples used in this evaluation were analyzed between 1990 and 2001. Although the sampling methodology and analytical methods are unknown, the data are considered useable for this evaluation

##### **4.2.4.1 Lead**

**Surface:** There are a total of 344 surficial sediment samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for lead. The surficial sediment samples for lead exceeded the ER-M guidance value of 218 ppm in 65% of the samples. The surficial concentration for lead is mapped in Figure 4-3 for the entire 17-mile tidal reach of the Passaic River Restoration Project Study Area. As shown in Figure 4-3, the majority of the elevated concentrations of lead were detected between River Miles (RMs) 2-4 (Harrison Reach) and 6-7 (Newark and Kearney). In the Upstream Reach, there were few samples with concentrations above the ER-M guidance values; however, very limited sampling was conducted in this reach. The maximum surficial concentration of 2,200 ppm, which is approximately an order of magnitude greater than the ER-M guidance value, was detected in the Upstream Reach. The reading was taken at approximately RM 17, which is approximately one mile down-estuary of the Dundee Dam.

**Subsurface:** There are a total of 619 subsurface samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for lead. To further examine the spatial distribution of the lead contamination, subsurface mapping was created for the peak RM interval of 2-4 miles, which is located in the Harrison Reach. Four depth intervals were mapped for each RM interval: 0.5-1, 1-3, 3-6, and 6-20 feet. Figure 4-4 shows the spatial distribution of the lead contamination at different depth intervals. There were no samples collected at the depth interval 0.5 -1 foot. The area of

concern occurs from RM 2-4.5 where the elevated concentrations of contamination are detected. The highest subsurface reading of 2,200 ppm is located at the split of the Harrison and Newark reach at a depth of approximately 0 - 6.0 feet. At the next depth interval, greater than six feet, the data point concentration decreases; however, the majority of the samples remain above the ER-M guidance value.

#### **4.2.4.2 Mercury**

**Surface:** There are a total of 344 surficial sediment samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for mercury. The surficial sediment samples for mercury exceeded the ER-M guidance value of 0.71 ppm in 70% of the samples. The surficial concentration for mercury is mapped in Figure 4-5 for the entire 17-mile tidal reach of the Passaic River Restoration Project Study Area. As shown in Figure 4-5, the majority of the elevated concentrations of mercury were detected in River Miles (RMs) 0-7 (Point No Point, Harrison Reach, Newark and Kearney). In the Upstream Reach, there were a few samples with concentrations above the ER-M guidance value; however, very limited sampling was conducted in this reach. The maximum surficial concentration of 12.4 ppm was detected in the Upstream Reach which is about two orders of magnitude greater than the ER-M guidance value. The reading was taken at RM 8.7.

**Subsurface:** There are a total of 618 subsurface samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for mercury. To further examine the spatial distribution of the mercury contamination, subsurface mapping was created for the peak RM interval of 2-4 miles, which is located in the Harrison Reach. Four depth intervals were mapped for each RM interval: 0.5-1 feet, 1-3 feet, 3-6 feet, and 6-20 feet. Figure 4-6 shows the spatial distribution of the mercury contamination at different depth intervals. There were no samples collected at the depth interval 0.5 -1 foot. The area of concern occurs from RMs 2-4.5 where the elevated concentrations of contamination are detected. The highest subsurface reading of 29.6 ppm is located in the Harrison Reach at a depth of approximately 12 feet. At the

next depth interval, greater than six feet, the data point concentration decreases; however, the majority of the samples remain above the ER-M guidance value.

#### **4.2.4.3 Silver**

**Surface:** There are a total of 341 surficial sediment samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for silver. The surficial sediment samples for mercury exceeded the ER-M guidance value of 3.7 ppm in 37% of the samples. The surficial concentration for silver is mapped in Figure 4-7 for the entire 17-mile tidal reach of the Passaic River Restoration Project Study Area. As shown in Figure 4-7, the majority of the elevated concentrations of silver were detected in RMs 0-7 (Point No Point, Harrison Reach, Newark and Kearney). In the Upstream Reach between RM 6.6-8, there were a few samples with concentrations above the ER-M guidance value; however, very limited sampling was conducted in this reach. The maximum surficial concentration of 39.5 ppm, which is about an order of magnitude greater than the ER-M guidance value, was detected in the Upstream Reach.

**Subsurface:** There are a total of 616 subsurface samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for silver. To further examine the spatial distribution of the silver contamination, subsurface mapping was created for the peak RM interval of 2-4 miles, which is located in the Harrison Reach. Four depth intervals were mapped for each RM interval: 0.5-1 feet, 1-3 feet, 3-6 feet, and 6-20 feet. Figure 4-8 shows the spatial distribution of the silver contamination at different depth intervals. There were no samples collected at the depth interval 0.5 -1 foot. The area of concern occurs from RM 2-4.5 where the elevated concentrations of contamination are detected. The highest subsurface reading of 26.7 ppm is located in the Harrison at a depth of approximately 12 feet. At the next depth interval, greater than six feet, the data point concentration decreases; however, the majority of the samples remain above the ER-M guidance value.

#### **4.2.4.4 Cobalt**

**Surface:** There are a total of 321 surficial sediment samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for cobalt. Cobalt was detected in 93% of the total collected samples. The surficial concentration for cobalt is mapped in Figure 4-9 for the entire 17-mile tidal reach of the Passaic River Restoration Project Study Area. As shown in Figure 4-9, the majority of the elevated concentrations of cobalt were detected in RMs 0-7 (Point No Point, Harrison Reach, Newark and Kearney). In the Upstream Reach between RM 6.6-8, there were a few samples with concentrations above the ER-M guidance value; however, very limited sampling was conducted in this reach. The maximum surficial concentration of 41.1 ppm was detected in the Harrison Reach.

**Subsurface:** There are a total of 616 subsurface samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for cobalt. To further examine the spatial distribution of the cobalt contamination, subsurface mapping was created for the peak RM interval of 2-4 miles, which is located in the Harrison Reach. Four depth intervals were mapped for each RM interval: 0.5-1 feet, 1-3 feet, 3-6 feet, and 6-20 feet. Figure 4-10 shows the spatial distribution of the cobalt contamination at different depth intervals. There were no samples collected at the depth interval 0.5 -1 foot. The area of concern occurs from RM 0-4.5 where the elevated concentrations of contamination are detected. The highest subsurface reading of 42.9 ppm is located in the Point No Point at a depth of approximately 2.3 feet at RM 1.64. At the next depth interval, greater than six feet, the data point concentration decreases; however, the majority of the samples remain above the ER-M guidance value.

#### **4.2.4.5 Zinc**

**Surface:** There are a total of 344 surficial sediment samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for zinc. The surficial sediment samples for zinc exceeded the ER-M guidance value of 410 ppm in 62% of the samples. The surficial concentration for zinc is mapped in Figure 4-

11 for the entire 17-mile tidal reach of the Passaic River Restoration Project Study Area. As shown in Figure 4-11, the majority of the elevated concentrations of zinc were detected between RMs 0-7 (Point No Point, Harrison Reach, Newark and Kearney). In the Upstream Reach, there were a few samples with concentrations above the ER-M guidance value; however, very limited sampling was conducted in this reach. The maximum surficial concentration of 1900 ppm, which is approximately an order of magnitude above the ER-M guidance value, was detected in the Upstream Reach.

**Subsurface:** There are a total of 619 subsurface samples collected from the Point No Point, Harrison, Newark, Kearny and Upstream reaches that were analyzed for zinc. To further examine the spatial distribution of the zinc contamination, subsurface mapping was created for the peak RM interval of 2-4 miles, which is located in the Harrison Reach. Four depth intervals were mapped for each RM interval: 0.5-1 feet, 1-3 feet, 3-6 feet, and 6-20 feet. Figure 4-12 shows the spatial distribution of the zinc contamination at different depth intervals. There were no samples collected at the depth interval 0.5 -1 foot. The area of concern occurs from RM 0-4.5 where the elevated concentrations of contamination are detected. The highest subsurface reading of 3110 ppm is located in the Point No Point at a depth of approximately 4.5 feet at RM 1.23. At the next depth interval, greater than six feet, the data point concentration decreases; however, the majority of the samples remain above the ER-M guidance value.

## **4.2.5 Comments**

### **4.2.5.1 Summary**

While conducting this evaluation, a review of “*A Geostatistical Assessment of Metals in Passaic River Sediment*” (2003) was completed to compare these results with the conclusions drawn by Katherine Chartrand. Although, her data analyses were conducted using complex statistical methods and sophisticated 3-D modeling, similar observations were obtained by the data analyses conducted in this historical evaluation.

- The patterns of spatial distribution are very similar among all the COPCs metals. Therefore, it appears likely that at least some of the processes that distribute the different metals are the same.
- The major areas of elevated concentration are located in deep sediments in the Point No Point, Harrison, Newark and Kearny reaches.
- The metal COPCs have elevated surficial sediment concentrations. This may indicate that contamination is ongoing from active (at the time the data were collected) sources.

#### **4.2.5.2 Data Gaps**

- No sediment samples were collected from the 0.5 to 1 foot interval for metals. Therefore, sampling will need to be conducted at this depth for the metal COPCs as part of the RI.
- There are elevated sample concentrations at the intersection of Third River and the Passaic River; however, no data from the Third River are available. To determine if the Third River is a source of metals contamination in the study area, sediment samples should be collected from the Third River as part of the RI.
- For all five metal COPCs, the subsurface maps show elevated concentrations (relative to the SQG) of contamination at the deepest sampled depth interval. However, the vertical extent of the contamination could not be determined based on the available sampling data. Additional samples may need to be collected to delineate the vertical extent of the contamination.
- The majority of the samples were collected from the Harrison Reach (~45%). Additional contamination depth and spatial distribution data will be needed to estimate the amount of inventory in the river so that target areas for clean-up can be accurately established.
- Subsurface contamination was examined only for limited river miles where surficial data showed elevated readings. This could mean that the elevated concentrations that are buried from erosion and common river events (*e.g.*, dumping, boat/barge traffic, 100-year storms) were not identified. Therefore, detailed subsurface data evaluation of the entire 17-mile tidal reach of the Passaic River Restoration Project Study Area and Harbor Reach below RM 1 along with the neighboring rivers such as Berry's Creek and the Hackensack River will need to be conducted as part of RI.
- Nearly all of the mercury samples were analyzed for total mercury, without any speciation. Since methylmercury is the most toxic form of mercury, samples will need to be collected and analyzed for the different forms of mercury.

## 4.3 PESTICIDE/HERBICIDE

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### 4.3.1 Preliminary Screening of Database for Pesticides COPCs

At the time of this evaluation, PREmis contained 11 different studies for which samples were collected and analyzed for pesticides. Altogether, the database contained 261 surficial sediment samples (defined as those samples collected within the top 6 inches) and 626 subsurface sediment samples. These samples were analyzed for 2,4'-Dichlorodiphenyldichloroethylene (DDE), 4,4'-Dichlorodiphenyldichloroethane (DDD), 4,4'-Dichlorodiphenyltrichloroethane (DDT), 2,4'-DDD, 2,4'-DDT, 4,4'-DDE, alpha-Chlordane (cis), gamma-Chlordane (trans), oxy-Chlordane, Nonachlor, cis-, Nonachlor, trans-, total Chlordane, alpha-benzene hexachloride (BHC), beta-BHC, delta-BHC, gamma-BHC, Dieldrin, Endrin, Endrin aldehyde, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Mirex, Toxaphene, Aldrin, Dieldrin + aldrin total, Endosulfan sulfate, Endosulfan, alpha, Endosulfan, beta, Endrin ketone, and Methoxychlor. Not all samples were analyzed for all compounds.

The guidelines used for comparison was the 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines (Long *et al.*, 1995) Effects Range - Medium (ER-M). Within the (ER-M) data there was only one guideline available for pesticides, total DDT. Therefore, the more conservative guidelines from the 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines (Long *et al.*, 1995) Effects Range - Low (ER-L) were used for the following nine compounds: 4,4'-DDT, 4,4'-DDE, total Chlordane, Dieldrin, Endrin, Heptachlor epoxide, Hexachlorobenzene, Mirex, and Aldrin. All of these compounds were evaluated based on how many samples exceeded the ER-M, or if applicable, the ER-L guidelines. If 25% of the samples analyzed for a specific compound exceeded the action level guidelines, the compound was considered a COPC. For the remaining compounds that did not have comparison guidelines, the contaminant was considered a COPC if the compound was detected in 50% of the samples.

#### **4.3.2 DDT, DDE, DDD**

All six DDT isomers were found at elevated concentrations within the Passaic River and are considered COPCs. The samples found in the database contain specific isomer concentrations and total DDT concentrations. Total DDT is the sum of the different isomers analyzed in the sample. There are a total of 257 samples in the database that were analyzed for DDTs. Of those, 245 samples were only screened for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD, which were then summed together and reported as total DDT. The other 12 samples were analyzed for all six isomers and all six were summed and reported as total DDT.

DDT contamination is expected in highly urbanized areas similar to the Lower Passaic Study Area. At the Diamond Alkali Superfund Site (approximately River Mile 3.2), Kolker Chemical Works produced DDT from sometime before World War II up until the 1950's when the production shifted out of state. It is estimated that 100 million pounds of DDT were produced at the site with DDT and its byproducts getting directly discharged into the river during plant production. When DDT is produced for use as a pesticide 4,4'-DDT is the desired isomer; however, during manufacture, the actual product produced is approximately 75% 4,4'-DDT and 25% 2,4'-DDT. The historical sediment data reviewed for this evaluation appeared to contain a similar ratio of 4,4'-DDT to 2,4'-DDT. DDT is broken down into DDD and DDE relatively quickly; during degradation the configuration will remain relatively consistent as it is released into the environment. This can be seen in the available data. Therefore, for simplicity of this evaluation the total reported for the sum of the three 4,4' isomers can be effectively compared with the comparison guidelines set for the sum of all six isomers. The comparison guidelines to be used for total DDT is the ER-M value of 46 parts per billion (ppb). (SETAC Prague poster presentation. U.S. Department of Commerce/National Oceanic and Atmospheric /National Ocean Service. April 2004 and <http://www.atsdr.cdc.gov/toxfaq.html>, last accessed April 29, 2004)



### **4.3.3 Chlordane**

The database contains Chlordane data in a variety of formats; concentration data for each of the five isomers of Chlordane, the total concentration of the alpha and gamma isomers, and the total concentration of all five isomers. There are a total of 259 samples that have been analyzed for Chlordane. The majority of samples, 222, were only analyzed for the two most prevalently found isomers, alpha and gamma. These two were summed and reported as total chlordane. The remaining 37 samples were screened for all five isomers and then their concentrations were summed and reported as total chlordane. Because the alpha and gamma isomers are the most prevalent, for this evaluation, the sums of the alpha and gamma isomers will be used for comparison to the guidelines value for total Chlordane. The comparison guidelines to be used for total Chlordane is the ER-L value of 46 parts per billion (ppb). (<http://www.atsdr.cdc.gov/toxfaq.html>, last accessed April 29, 2004)

After applying these guidelines to the samples within the database four pesticide COPCs were identified. The following sections provide detailed statistical and action level reports results for these four COPCs.

- Total DDT
- Total Chordane
- Dieldrin
- Mirex

### **4.3.4 Herbicides**

At the time of this evaluation, PREmis contained 4 different studies for which samples were collected and analyzed for herbicides. Altogether, the database contained 473 surficial sediment samples (defined as those samples collected within the top 6 inches) and 170 subsurface sediment samples. These samples were analyzed for 2,4-Dichlorophenoxyacetic acid (2,4-D), 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T), 2,4,5

Trichlorophenoxypropionic acid (2,4,5-TP), and 2,4-Dichlorophenoxybutyric acid (2,4-DB). Not all samples were analyzed for all compounds.

None of the herbicides reviewed in this evaluation have 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines (Long *et al.*, 1995) ER-M or ER-L values. For these compounds the contaminant was considered a COPC if the compound was detected in at least 50% of the samples.

As described in Section 2.2 of the Pre-Expansion Activity Plan (July 2003), the Diamond Alkali site produced 2,4-D, 2,4,5-T and 2,4,5-Trichlorophenol, two of which were analyzed for in the available data. The database was queried and the compounds were pulled into a statistical report to examine detection frequencies. All detection frequencies were below 3%, which may indicate that the herbicides have been flushed from the system. This can be explained by the nature and use of herbicides. Typically, herbicides are produced to have high water solubility so that they are readily absorbed by plant foliage and root systems. Therefore, as a herbicide is released into a riverine environment, such as the Lower Passaic River, the compound will likely be rapidly flushed downstream or taken up by any nearby plants. Herbicides do not have the bioaccumulative and persistent properties necessary to remain in river sediments. Therefore, herbicides will not be discussed any further in this evaluation.

#### **4.3.5 Detailed Evaluation of COPCs**

The four COPCs identified from the initial evaluation were further analyzed through mapping surface and subsurface data points in the river. From these analyses the extent of contamination was identified and any data gaps that exist will be considered for future sampling events. Below is a table of the surficial sediment grabs.

**Table 4-4. Summary Table of Chemicals of Potential Concern – Surficial Sediment Grabs – Pesticides**

Summary Table of Chemicals of Potential Concern - Surficial Sediment Grabs									
Pesticides									
CAS Number	Chemical	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Criteria Value(ppb)	Exceedance Frequency
DDT_TOTAL	Total DDT	6.00E+00	5.98E+03	NG/G	2.31E+02	Harrison Reach	238 / 261	4.60E+01	216 / 261
57-74-9	Total Chlordane	3.00E+00	2.10E+02	NG/G	4.90E+01	Upstream Reach	130 / 232	7.00E+00	125 / 232
60-57-1	Dieldrin	4.00E+00	2.70E+02	NG/G	2.70E+01	Point No Point Reach	119 / 261	2.00E+00	119 / 261
2385-85-5	Mirex	9.00E+00	1.35E+02	NG/G	2.60E+01	Point No Point Reach	12 / 13	7.00E+00	12 / 13

#### 4.3.5.1 Total DDT

There are a total of 261 surficial sediment samples and 606 subsurface samples that were analyzed for Total DDT. The samples were collected between 1990 to 2000. Therefore, although the sampling and analytical methods for each study are not known, they will be considered satisfactory for this evaluation and all the data will be considered useable.

The surficial sediment samples exceeded the guideline value of 46 ppb 83% of the time. These data points were mapped in figure 4-13. As illustrated on this map, the highest concentrations occur from River Miles (RMs) 2-4 (Harrison Reach) and 6-7 (Newark and Kearney Reaches), with the highest measured value found in the Harrison Reach. The maximum surficial reading was measured at 5,980 ppb, which is approximately two orders or magnitude above the ER-M comparison guideline. This reading was taken at RM 2.21, which is approximately one mile down-estuary of the Diamond Alkali Superfund Site.

Below is a summary table of the data from the subsurface samples.

**Table 4-5. Summary Table Chemicals of Potential Concern: Subsurface Samples – Total DDT**

Summary Table Chemicals of Potential Concern: Subsurface Samples								
Total DDT								
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency	Criteria Value(ppb)	Exceedance Frequency	Percent Exceedance
Point No Point Reach	9.00E+00	4.47E+03	NG/G	2.76E+02	79 / 96	4.60E+01	72 / 96	75.00%
Harrison Reach	8.00E+00	1.86E+07	NG/G	1.28E+05	225 / 287	4.60E+01	203 / 287	70.73%
Newark Reach	5.00E+00	2.30E+03	NG/G	3.03E+02	87 / 128	4.60E+01	69 / 128	53.91%
Kearny Reach	1.01E+02	2.44E+03	NG/G	5.73E+02	64 / 71	4.60E+01	64 / 71	90.14%
Upstream Reach	5.00E+00	5.07E+02	NG/G	1.61E+02	16 / 24	4.60E+01	9 / 24	37.50%

The two RM intervals that showed the highest surface concentrations were mapped at subsurface depths to further examine the spatial distribution of contamination. The subsurface maps illustrate Total DDT concentrations in the following depth intervals: 0.5 feet to 1 foot, 1 foot to 3 feet, 3 feet to 6 feet, and 6 feet to 20 feet. Refer to Figure 4-14 for the subsurface distribution of total DDT within RMs 2-4. As shown on this figure, no samples were collected at the depth interval 0.5 feet to 1 foot. For the deeper subsurface depths intervals, the area of concern occurs at RM 3-3.5 where the highest levels of contamination are reported. The highest subsurface concentration is found in this interval at a depth of approximately three feet. The reported concentration is 18,600,000 ppb; which is six orders of magnitude above the ER-M guideline value. It should be noted that this sample concentration is anomalous when compared to all of the other sample results. Therefore, it is possible that this value is unreliable. At the next depth interval, greater than six feet, the concentration drops, however, still remains above the ER-M guideline. Many of the reported concentrations in the deepest interval remain well above the guideline.

Refer to Figure 4-15 for subsurface mapping of RMs 6-7. The samples with the highest subsurface DDT concentrations in this stretch of river are located at the interface of the Newark and Kearney Reaches. The highest reported subsurface concentration in this stretch of river is 2,440 ppb taken from 3 to 5 feet at RM 6.5. At RM 6.25 the map

shows a concentration gradient that increases with depth. The data is sparse at the deepest interval of 6 feet to 20 feet.

#### 4.3.5.2 Total Chlordane

There are a total of 232 surficial sediment samples and 578 subsurface samples that were analyzed for Total Chlordane. The samples were collected between 1990 to 2000. Therefore, although the sampling and analytical methods for each study are not known, they will be considered satisfactory for this evaluation and all the data will be considered useable.

The surficial sediment samples exceeded the guideline value of 7 ppb 54% of the time. The data points were mapped in figure 4-16. As illustrated in the map, the most frequent exceedences reported occur from RM 2-4 (Harrison Reach). The highest reported surficial concentration, 403 ppb, was measured in the Kearney Reach at approximately RM 6.5.

Below is a summary table of the data from the subsurface samples.

**Table 4-6. Summary Table Chemicals of Potential Concern: Subsurface Samples – Total Chlordane**

Summary Table Chemicals of Potential Concern: Subsurface Samples								
Total Chlordane								
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency	Criteria Value(ppb)	Exceedance Frequency	Percent Exceedance
Point No Point Reach	7.00E+00	7.91E+02	NG/G	6.80E+01	60 / 94	7.00E+00	58 / 94	62.77%
Harrison Reach	5.00E+00	2.57E+02	NG/G	7.00E+01	135 / 270	5.00E-01	134 / 270	50.00%
Newark Reach	3.00E+00	3.44E+02	NG/G	7.90E+01	57 / 119	7.00E+00	54 / 119	46.22%
Kearny Reach	3.00E+00	4.03E+02	NG/G	7.80E+01	61 / 71	7.00E+00	54 / 71	77.46%
Upstream Reach	3.00E+00	1.26E+02	NG/G	4.40E+01	15 / 24	7.00E+00	11 / 24	50.00%

RM intervals 2-4 (Harrison Reach) and 1-2 (Point No Point Reach) were chosen for subsurface mapping to further examine the spatial distribution of contamination. The subsurface maps illustrate Total Chlordane concentrations in the following depth intervals: 0.5 feet to 1 foot, 1 foot to 3 feet, 3 feet to 6 feet, and 6 feet to 20 feet. Refer to Figure 4-17 for the subsurface distribution of Total Chlordane within RMs 1-2. Only one

sample result was reported at the depth interval 0.5 feet to 1 foot and it is in exceedance of the ER-L comparison guideline. An area of potential concern occurs from RM 1-2.7 where the highest levels of contamination are reported. The highest reported subsurface reading in the entire dataset, 791 ppb, is located within this interval at a depth of 2.5'-3.5'. This depth interval had the highest number of reported exceedances at an order of magnitude over the guideline concentration.

Refer to figure 4-18 for the subsurface distribution of total Chlordane within RMs 2-4. The map illustrates a possible area of high contamination located near the Diamond Alkali Superfund Site at approximately RM 3.2. The highest reported concentrations occur at depths 1'-6', as seen in the figure. The deepest depth interval has concentrations that remain well above ER-L exceedance guideline values.

#### **4.3.5.3 Dieldrin**

There are a total of 261 surficial sediment samples and 615 subsurface samples that were analyzed for Total Dieldrin. The samples were collected between 1990 to 2000. Therefore, although the sampling and analytical methods for each study are not known, they will be considered satisfactory for this evaluation and all the data will be considered useable.

The surficial sediment samples exceeded the guideline value of 2 ppb 46% of the time. The data points were mapped in figure 4-19. As illustrated in the map, the most frequent exceedances occur from RM 2-4.5 (Harrison Reach). The highest surficial concentration, 270 ppb was measured in the Point No Point at approximately RM 1.1.

Below is a summary table of the data from the subsurface samples.

**Table 4-7. Summary Table Chemicals of Potential Concern: Subsurface Samples – Dieldrin**

Summary Table Chemicals of Potential Concern: Subsurface Samples								
Dieldrin								
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency	Criteria Value(ppb)	Exceedance Frequency	Percent Exceedance
Point No Point Reach	9.00E+00	5.80E+02	NG/G	5.50E+01	48 / 96	2.00E+00	48 / 96	50.00%
Harrison Reach	1.30E+00	4.55E+02	NG/G	7.00E+01	140 / 290	2.00E+00	139 / 290	47.93%
Newark Reach	8.00E+00	2.54E+02	NG/G	5.80E+01	64 / 134	2.00E+00	64 / 134	47.76%
Kearny Reach	1.10E+01	1.73E+02	NG/G	5.40E+01	51 / 71	2.00E+00	51/ 71	71.83%
Upstream Reach	8.00E+00	2.10E+02	NG/G	6.50E+01	10 / 24	2.00E+00	10/24	41.67%

RM interval 2-4.5 (Harrison Reach) was chosen for subsurface mapping to further examine the spatial distribution of contamination. The subsurface maps illustrate Dieldrin concentrations in the following depth intervals: 0.5 feet to 1 foot, 1 foot to 3 feet, 3 feet to 6 feet, and 6 feet to 20 feet. Refer to Figure 4-20 for the subsurface distribution of total Chlordane within RMs 2-4.5. As shown on this figure, no samples were collected at the depth interval 0.5 feet to 1 foot. The figure suggests there is a possible area of highly contaminated sediments located near the Diamond Alkali Superfund Site at approximately RM 3.2. The highest reported concentration, 455 ppb, occurs at the depth 3.5 feet to 4.5 feet. The reported sediment concentrations in the 6 feet to 20 feet interval remain well above ER-L guideline values.

#### **4.3.5.4 Mirex**

There are a total of 13 surficial sediment samples and no subsurface samples that were analyzed for Mirex. The samples were collected between 1990 to 2000. Therefore, although the sampling and analytical methods for each study are not known, they will be considered satisfactory for this evaluation and all the data will be considered useable.

The surficial sediment samples exceeded the ER-L guideline value of 7 ppb 92% of the time. The data points were mapped in figure 4-21. In examining the map the most frequent exceedences occur from RM 2-4 (Harrison Reach). The highest reported

surficial concentration, 134.95 ppb, was measured in the Harrison Reach at approximately RM 2.1.

#### **4.3.6 Data Gaps for COPC Evaluation**

For the evaluated COPC data, the following data gaps were identified as a result of this evaluation. Note that some of these data gaps may change once the CARP data is available.

- There is little to no data for the 0.5 feet-1 feet interval.
- There are elevated samples (relative to the (SQG) at the intersection of Third River and the Passaic River. However, it is not possible to characterize the area down-estuary of this intersection due to insufficient sampling points.
- Subsurface mapping illustrate elevated concentrations at the bottom of sediment borings well above guidelines.
- There is little or no data for Mirex.
- The Upstream Reach contains few sample points. It encompasses 67% of the total Study Area, while the other four reaches (*i.e.*, Point No Point, Harrison, Newark, and Kearny) make up the remaining 33%. This ratio is not consistent with the number of sample points taken throughout the Study Area. The following breakdown demonstrates the existing number of sample points (for samples used in this evaluation) collected in the Upstream Reach vs. the other evaluated reaches:
- Total Surficial Sample Breakdown: Total DDT: Upstream 17%, Other Reaches 83%; Total Chlordane: Upstream 19%, Other Reaches 81%; Dieldrin: Upstream 17%, Other Reaches 83%; and Mirex: Upstream 15%, Other Reaches 85%.
- Total Subsurface Sample Breakdown: Total DDT: Upstream 4%, Other Reaches 96%; Total Chlordane: Upstream 4%, Other Reaches 96%; Dieldrin: Upstream 4%, Other Reaches 96%; and Mirex: Upstream 0%, Other Reaches 0%.

#### **4.3.7 Recommendations for Additional Evaluation**

For the evaluated COPC data, the following recommendations for additional evaluation were identified as a result of this evaluation. Note that some of these recommendations may change once the CARP data is available.



- Subsurface maps were only evaluated for limited river stretches. It is recommended that subsurface mapping for the entire study area be analyzed to look for buried contamination from erosion and common river events (*e.g.*, dumping, boat/barge traffic, 100-year storms).
- It is recommended that sampling take place at deeper depths until concentrations decrease to below guideline values. This will aid in determining contamination depth and spatial distribution to establish the amount of inventory so that target areas for clean-up can be accurately established.
- It is recommended that consistent laboratory qualifier abbreviations be established. Data for this evaluation were inconsistent with reported lettering, so data that had no laboratory qualifier or unknown laboratory qualifier abbreviations were considered detected.
- It is recommended that all data be examined in the Harbor Reach and neighboring river systems (*e.g.*, Hackensack River, Berry's Creek). For this evaluation only RMs 1 to 17 were analyzed.
- It is recommended that more surficial and subsurface samples be taken throughout the river for Mirex.
- It is recommended that more sampling take place in the Upstream Reach comparable to the other reaches evaluated.

## 4.4 VOCS & SVOCS

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### 4.4.1 Preliminary Screening of Database for VOC COPCs

VOC samples from the following five historical studies were used in this historical data evaluation.

- PASSAIC 1992 Core Sediment Investigation
- PASSAIC 1993 Core Sediment Investigation - 02 (July);
- PASSAIC 1994 Surficial Sediment Investigation;
- PASSAIC 1995 USACE Minish Park Investigation;
- PASSAIC 1995 RI Sampling Program.

Altogether, the database contained 142 surficial sediment samples (defined as those samples collected within the top 6 inches of sediment) and 537 subsurface sediment samples. For the purposes of this evaluation, VOCs were broken into three subclasses: BTEX (i.e., benzene, toluene, ethylbenzene, xylenes), chlorinated VOCs, and other VOCs. The chemicals contained in each subclass can be seen in Table 4-8. Note that not all VOCs were analyzed for in each sample.

Typically, COPCs were selected based on comparison to either the 1998 NJDEP Marine/Estuarine Sediment Screening Guideline ER-M or ER-L values. However, ER-M/ER-L values are not available for any of the VOCs. Therefore, for this evaluation, since all available screening guidelines are classified as “To Be Considered” (TBC) screening values, the most conservative screening guideline from the available TBCs was chosen for each chemical.

For chemicals with screening guidelines, if 25% of the samples analyzed exceeded the corresponding screening level guideline, then the chemical was considered a COPC. For chemicals which do not have screening guidelines, the chemicals COPCs were selected based on frequency of detection; that is, if a compound was detected in 50% or more of the samples collected, then it was considered for inclusion on the COPC list. Other factors were also evaluated including, but not limited to, distribution in the study area, the toxicological nature of the chemical, physicochemical properties of the chemical, the reliability and accuracy of analytical methodologies available at the time of sampling, and whether the chemical is a common laboratory contaminant.

The percentage of samples collected from each reach of the Passaic River was evaluated and is detailed below:

For surficial sediment data:

- 17% of VOC samples were collected in the Point No Point Reach;

- 40% of VOC samples were collected in the Harrison Reach;
- 19% of VOC samples were collected in the Newark Reach;
- 9% of VOC samples were collected in the Kearny Reach;
- 15% of VOC samples were collected in the Upstream Reach.

For subsurface sediment data:

- 17% of VOC samples were collected in the Point No Point Reach;
- 43% of VOC samples were collected in the Harrison Reach;
- 26% of VOC samples were collected in the Newark Reach;
- 14% of VOC samples were collected in the Kearny Reach;
- <1% of VOC samples were collected in the Upstream Reach.

The following sections provide the following for each subclass of chemicals:

- Introduction – a summary of which (if any) chemicals are selected as COPCs;
- Surficial Sediments – a summary of historical sampling results in surficial sediment;
- Subsurface Sediments – a summary of historical sampling results in subsurface sediment;
- COPC Selection – discussion of which chemicals (if any) were selected as COPCs, why they were selected (or not selected), maps created, background of relevant chemicals, and potential sources of chemicals to the Passaic River;

At the end of this section, discussion of existing data gaps, limitations, and recommendations are provided for further investigation of COPCs as appropriate.

#### **4.4.1.1 BTEX VOCs**

##### ***Introduction***

For the chemicals classified as “BTEX VOCs,” total xylenes are retained as COPCs since they exceeded available screening guidelines in 41% of subsurface historical sediment samples. Benzene, ethylbenzene, and toluene are not retained for

consideration as COPCs based on the low frequency of exceedance of available screening guidelines in both surface and subsurface historical sediment samples. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

### ***Surficial Sediments***

A total of 142 surface sediment samples in the database were analyzed for BTEX constituents. BTEX compounds were detected throughout the Passaic River, but were typically found in less than 10% of the total historical samples analyzed for the individual constituents. Benzene, ethylbenzene, toluene, and total xylenes exceeded the screening level selected in 1%, 1%, 4%, and 6% of historical samples collected, respectively. Table 4-9 provides a statistical report of historical sampling results for BTEX VOCs.

### ***Subsurface Sediments***

A total of 537 subsurface sediment samples in the database were analyzed for BTEX constituents. BTEX compounds were detected throughout the Passaic River: benzene, ethylbenzene, and toluene were found in less than 20% of the total historical samples analyzed for the individual constituents, while total xylenes were found in 47% of total historical samples. Benzene, ethylbenzene, toluene, and total xylenes exceeded the screening level selected in 1%, 1%, 4%, and 41% of historical samples collected, respectively. Table 4-10 provides a statistical report of historical sampling results for BTEX VOCs.

### ***COPC Selection***

#### **Chemicals with Screening Guidelines**

Benzene, ethylbenzene, and toluene are not considered as COPCs based on the low frequency of exceedance in both surface and subsurface sediment samples. As a result, mapping was not conducted for these chemicals at the surface or subsurface level.

### ***Discussion of Total Xylenes***

As discussed above, total xylenes exceeded the screening level in 6% of surface sediment samples, and in 41% of subsurface sediment samples. The most conservative sediment screening guideline available was used as a default value for each chemical in this study. For total xylenes, this was the 1997 USEPA Office of Solid Waste and Emergency Response Ecotox Threshold value of 25 parts per billion (ppb). When the historical data for total xylenes are compared to other screening guidelines for xylenes, the exceedance frequencies are as follows:

- 1998 NJDEP Volatile Organic Sediment Screening Guidelines, Freshwater and Estuarine/Marine Systems (MacDonald et al., 1992): total xylenes exceeds the screening level (120 ppb) in 19% of historical samples collected;
- 1997 NAWQC Sediment Quality Benchmarks, Marine/Estuarine Chronic Values: total xylenes exceeds the screening level (160 ppb) in 16% of historical samples collected;
- 2003 USEPA Region 5, RCRA Ecological Screening Levels: total xylenes exceeds the screening level (433 ppb) in 5% of historical samples collected.

Xylenes are used as a solvent and in the printing, rubber, and leather industries. There are three xylene isomers: m-xylene, o-xylene, and p-xylene. According to the Agency for Toxic Substances and Disease Registry (ATSDR 1996a), this group of chemicals is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. Xylenes are derived from petroleum and have been found in waste sites and landfills when discarded as used solvent, or in varnish, paint, or paint thinners. The Lower Passaic River is bordered by roadways and various industries. As such, petroleum products may enter the river via runoff. Total xylenes are common contaminants resulting from petroleum products and industrial processes.

A map of surficial sediment results for total xylenes is provided as Figure 4-22. Total xylenes were detected in only 13 of the 142 samples collected, and exceeded the screening level in only 9 of the 142 samples. The highest concentration, 108 ppb, was

detected in the Point No Point Reach, at approximately River Mile 1.2. The other exceedance values are spread throughout the first 6.5 miles of the river.

A map of subsurface sediment results for total xylenes is provided as Figure 4-23. Subsurface sediment sampling results are shown for the following depth intervals: 0.5-1.0 feet, 1-3 feet, 3-6 feet, and 6-20 feet. Total xylenes were detected in 233 of the 526 samples collected, and exceeded the screening level in 216 of the 526 samples (using the most conservative screening level of 25 ppb). Four samples yielded results between 4,331-44,000 ppb (10-100 times higher than the USEPA Region 5 Ecological Screening Level). These concentrations occurred between 3-6 feet at River Miles (approximate) 2.85 (south shore), 3.25 (south shore), and 4.4 (north of center line), and between 6-20 feet at River Mile 2.85 (south shore).

For the three deepest subsurface samples (15.4-17.4 feet, 15.4-17.4 feet, and 14-17.3 feet, one sample exceeds the screening guideline (33 ppb at 14-17.3 feet). Further investigation may be required to determine the vertical extent of the contamination.

#### **4.4.1.2 Chlorinated VOCs**

##### ***Introduction***

None of the chemicals classified as “Chlorinated VOCs” are retained for consideration as COPCs based on the low frequency of exceedance of available screening guidelines in both surface and subsurface historical sediment samples. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

##### ***Surficial Sediment***

A total of 142 surface sediment samples in the database were analyzed for Chlorinated VOC chemicals. From the historical results, two chemicals (chlorobenzene and methylene chloride) were detected for which screening level guidelines are available, and three chemicals (1,2-dichloroethylene, methyl bromide, and methyl chloride) were

detected for which screening level guidelines are not available. Table 4-11 provides a statistical report of historical sampling results for Chlorinated VOCs.

### **Chemicals with Screening Guidelines**

Chlorobenzene exceeded the screening level in 1% of samples collected, and methylene chloride did not exceed the screening level in any samples collected. Methylene chloride is a common laboratory contaminant.

### **Chemicals without Screening Guidelines**

1,2-Dichloroethylene, methyl bromide, and methyl chloride were detected in 2%, 1%, and 4% of historical samples collected.

### ***Subsurface Sediment***

A total of 537 subsurface sediment samples in the database were analyzed for Chlorinated VOC chemicals. From the historical results, four chemicals (chlorobenzene, methylene chloride, tetrachloroethylene, and trichloroethylene) were detected for which screening level guidelines are available, and six chemicals (1,1-dichloroethane, 1,2-dichloropropane, 1,1-dichloroethene, 1,1,2,2-tetrachloroethane, methyl chloride, and vinyl chloride) were detected for which screening level guidelines are not available. Table 4-12 provides a statistical report of historical sampling results for Chlorinated VOCs.

### **Chemicals with Screening Guidelines**

Chlorobenzene exceeded the screening level in 2% of samples collected; methylene chloride exceeded the screening level in less than 1% of samples collected; tetrachloroethylene did not exceed the screening level in any samples collected; trichloroethylene did not exceed the screening level in any samples collected. Methylene chloride is a common laboratory contaminant.

## **Chemicals without Screening Guidelines**

1,1-Dichloroethane, 1,2-dichloroethylene, 1,2-dichloropropane, 1,1-dichloroethene, methyl bromide, methyl chloride, 1,1,2,2-tetrachloroethane, and vinyl chloride were each detected in less than 1% of historical samples collected.

### ***COPC Selection***

Based on available historical data, frequency of exceedance (for chemicals with available screening guidelines), and frequency of detection (for chemicals with no available screening guidelines), no chemicals from the Chlorinated VOCs subclass are recommended for consideration as COPCs. As a result, mapping was not conducted for any of the Chlorinated VOC chemicals at the surface or subsurface level.

#### **4.4.1.3 Other VOCs**

##### ***Introduction***

Of the chemicals classified as “Other VOCs,” methyl ethyl ketone (MEK) is retained as a COPC since it exceeded available screening guidelines in 37% of subsurface historical sediment samples, it was present in hot spot areas, and it is a chemical that is usually not persistent in sediments. All other chemicals classified as “Other VOCs” are not selected as COPCs based on the low frequency of exceedance of available screening guidelines in both surface and subsurface historical sediment samples. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

##### ***Surficial Sediment***

A total of 142 surface sediment samples in the database were analyzed for Other VOC chemicals. From the historical results, three chemicals (acetone, carbon disulfide, and methyl ethyl ketone) were detected for which screening level guidelines are available, and one group of chemicals (acid volatile sulfides, historical) were detected for which screening level guidelines are not available. Table 4-13 provides a statistical report of historical sampling results for Other VOCs.



Acetone was detected and exceeded the available screening level in 68% of historical samples collected. Carbon disulfide exceeded the screening level in 2% of historical samples collected. Methyl ethyl ketone exceeded the screening level in 6% of historical samples collected.

Acid volatile sulfides was detected in all samples collected; however, the sample size is small (n=11).

### ***Subsurface Sediment***

A total of 537 subsurface sediment samples in the database were analyzed for Other VOC chemicals. From the historical results, four chemicals (acetone, carbon disulfide, 2-hexanone, and methyl ethyl ketone) were detected for which screening level guidelines are available, and nine chemicals (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, bromobenzene, isopropylbenzene, n-butylbenzene, n-propylbenzene, p-isopropyltoluene, sec-butylbenzene, and styrene) were detected for which screening level guidelines are not available. Table 4-14 provides a statistical report of historical sampling results for Other VOCs.

### **Chemicals with Screening Guidelines**

Acetone exceeded the screening level in 75% of samples collected. Carbon disulfide, 2-hexanone, and methyl ethyl ketone exceeded the corresponding screening levels in 4%, less than 1%, and 37% of historical samples collected, respectively.

### **Chemicals without Screening Guidelines**

For the nine chemicals without screening guidelines, the sample size is small (n=11); except for bromobenzene and n-butylbenzene, each of these eight chemicals was detected at a frequency greater than 50%. Styrene was detected in less than 1% of historical samples (n=537).

### ***Selection of COPCs***

Based on available historical data, frequency of exceedance (for chemicals with available screening guidelines), and frequency of detection (for chemicals with no available screening guidelines), only one chemical classified in the “Other VOCs” subclass is recommended for consideration as a COPC – methyl ethyl ketone. This is summarized below. Maps of historical surface and subsurface sediment data were created for MEK, but not for any of the other chemicals in this subclass. A summary is provided below for each chemical that was detected in historical sediment sampling.

### **Chemicals with Screening Guidelines**

Acetone exceeded the screening level in both surface and subsurface sediment samples at high frequencies. Although acetone is a common laboratory contaminant, preliminary review of the historical data suggests that hot spots of elevated concentrations exist. Therefore, acetone cannot be eliminated as a COPC as part of this evaluation. Further investigation will be required to determine the reliability of sampling/analysis methods used for samples with elevated concentrations, as well as to determine potential sources of acetone to the Passaic River. Future sampling events will take into account the concentration of acetone and its distribution throughout the study area.

Carbon disulfide is not selected as a COPC based on the low frequency of exceedance in surficial and subsurface sediment. 2-Hexanone is not selected as a COPC based on the low frequency of exceedance in subsurface sediment.

### **Chemicals without Screening Guidelines**

Acid volatile sulfides were detected in all surficial sediment samples collected; however, this group of chemicals is not considered as a COPC based on the small sample size. Based on the low number of samples collected in subsurface sediment for 1,2,4-

trimethylbenzene, 1,3,5-trimethylbenzene, bromobenzene, isopropylbenzene, n-butylbenzene, n-propylbenzene, p-isopropyltoluene, sec-butylbenzene, and styrene, no conclusions about these contaminants can be drawn with the existing data. Currently, these chemicals are not considered as COPCs. However, once additional data is collected during the RI, these compounds may be reevaluated for inclusion as a COPC for the site.

### **Discussion of Methyl Ethyl Ketone**

Methyl ethyl ketone (MEK; also referred to as 2-butanone) is water-soluble and breaks down to simpler forms in approximately two weeks (ATSDR, 1995). According to ATSDR (1995), MEK does not accumulate at the bottom of lakes and rivers. However, the historical data for the Passaic River indicate that methyl ethyl ketone has deposited into the sediment. This indicates that a significant source of MEK to the environment may have been present. MEK is commonly used in paints, protective coatings, and oils.

A map of surficial sediment analytical results for MEK is provided as Figure 4-24. This map contains surficial sediment data for the entire 17-mile study area of the Passaic River. Of the 142 samples collected, there were 29 detects, 9 of which were at or above the screening level. The highest exceedances in surficial sediment are located at approximately River Miles 1.5, 1.7, 2.9, 4.1, and 6.5.

The 196 subsurface sediment samples which were in exceedance of the screening level had the following distribution:

- Point No Point - approximately 25%
- Harrison - approximately 50%
- Newark - approximately 15%
- Kearny - approximately 10%
- Upstream - less than 1%

A subsurface sediment map was generated for River Miles 1.75-4.5 and is provided as Figure 4-25. Subsurface sediment sampling results are shown for the following depth intervals: 0.5-1.0 feet, 1-3 feet, 3-6 feet, and 6-20 feet. MEK was detected in 315 of the 526 samples collected, and exceeded the screening level in 196 of the 526 samples. For the three deepest subsurface samples (15.4-17.4 feet, 15.4-17.4 feet, and 14-17.3 feet, two samples exceed the screening guideline (78 ppb at 15.4-17.4 feet, 110 ppb at 14-17.3 feet). Further investigation may be required to determine the vertical extent of the contamination.

As displayed in Figure 4-25, the highest concentrations of MEK in subsurface sediment were located at approximately River Mile 3.15 (3,000 ppb) and River Mile 3.25 (7,200 ppb) on the south shoreline. Benjamin Moore Paints has a facility located at 134 Lister Avenue, Newark, NJ, which is at approximately River Mile 3.1. Figure 4-26 illustrates the location of 134 Lister Avenue, Newark, NJ. This is located approximately ¼-mile south of the Passaic River. According to the Tree City Painting Company internet site (<http://www.treecitypainting.com/pages/626736/>), the Benjamin Moore Paint Company relocated to Newark, NJ in the 1920s. While no evidence is available to suggest that the Benjamin Moore Paint Company is a contributor of methyl ethyl ketone to the Passaic River, MEK is associated with paint manufacturing. It is important to note that the all industrial, manufacturing, chemical, Superfund, and other contaminated sites could not be evaluated for their proximity to the Passaic River, historical operations, or known releases to the environment.

#### **4.4.2 Data Gaps and Recommendations for VOCs**

- Only four historical samples provide data for subsurface sediment from 0.5-1.0 feet. Samples should be collected at this depth to provide further characterization of chemical concentrations in the subsurface sediment.
- Sediment samples for acetone, MEK, and total xylenes were collected at depths up to 17.4 feet below surface. Further investigation may be required to determine the vertical extent of contamination.

- The majority of surface sediment samples evaluated in this study were collected in the Harrison Reach (40%). The majority of subsurface sediment samples evaluated in this study were collected in the Harrison Reach (43%) and Newark Reach (26%). Future sampling events should include balanced representation of other reaches within the study area to determine the spatial distribution of contamination.
- Further investigation will be required to determine the sources of elevated levels of acetone, MEK, and xylene contamination in the subsurface sediment.

#### **4.4.3 Preliminary Screening of Database for SVOC COPCs**

The historical data contained in the Passaic River Estuary Management Information System (PREmis) database were reviewed in order to determine which semi-volatile organic compounds (SVOCs) are chemicals of potential concern (COPCs) for the Lower Passaic River Restoration Project. At the time of this evaluation, samples were collected and analyzed for SVOCs in the following 12 studies contained in PREmis:

- PASSAIC 1990 Surficial Sediment Investigation;
- PASSAIC 1991 Core Sediment Investigation;
- PASSAIC 1992 Core Sediment Investigation;
- NOAA NS&T Hudson-Raritan Phase II, 1993;
- PASSAIC 1993 Core Sediment Investigation - 01 (March);
- PASSAIC 1993 Core Sediment Investigation - 02 (July);
- REMAP, 1994;
- PASSAIC 1994 Surficial Sediment Investigation;
- PASSAIC 1995 USACE Minish Park Investigation;
- PASSAIC 1995 RI Sampling Program;
- PASSAIC 1999 Late Summer/Early Fall ESP Sampling Program;
- PASSAIC 1999/2000 Minish Park Monitoring Program;
- PASSAIC 2000 Spring ESP Sampling Program.

Altogether, the database contained 244 surficial sediment samples (defined as those samples collected within the top 6 inches of sediment) and 622 subsurface sediment samples. For the purposes of this evaluation, SVOCs were broken into the following subclasses: Phenolics, Phthalates, Polycyclic Aromatic Hydrocarbons (PAHs), and Other SVOCs. The chemicals contained in each subclass can be seen in Table 4-15. Note that not all SVOCs were analyzed for in each sample.

PAHs are further divided into Total PAHs, High-Molecular Weight (HMW) PAHs, and Low Molecular Weight (LMW) PAHs. HMW PAHs include the following six chemicals: Benz[a]anthracene, Benzo[a]pyrene, Chrysene, Dibenz[a,h]anthracene, Fluoranthene, and Pyrene. LMW PAHs include the following seven chemicals: Acenaphthene, Acenaphthylene, Anthracene, Fluorene, 2-Methylnaphthalene, Naphthalene, and Phenanthrene. Total PAHs represent the sum of the 6 HMW PAHs and the 7 LMW PAHs.

Typically, COPCs were selected based on comparison to either the 1998 NJDEP Marine/Estuarine Sediment Screening Guideline ER-M or ER-L values. However, ER-M/ER-L values are available only for the PAHs, and not for any of the other SVOCs. All available sediment screening guidelines are classified as “To Be Considered” (TBC) screening values. Therefore, for evaluation of Phenolic SVOCs, Phthalate SVOCs, and Other SVOCs, the most conservative screening guideline from the available TBCs was chosen for each chemical.

For chemicals with screening guidelines, if 25% of the samples analyzed exceeded the corresponding screening level guideline, then the chemical was considered for inclusion as a COPC. For chemicals which do not have screening guidelines, chemicals were considered for inclusion as COPCs based on frequency of detection; that is, if a compound was detected in 50% or more of the samples collected, then it was considered for inclusion on the COPC list. Other factors were also evaluated including, but not limited to, distribution in the study area, the toxicological nature of the chemical, physicochemical properties of the chemical, the reliability and accuracy of analytical

methodologies available at the time of sampling, and whether the chemical is a common laboratory contaminant.

The percentage of samples collected from each reach of the Passaic River was evaluated and is detailed below:

***For surficial sediment data:***

- 16% of SVOC samples were collected in the Point No Point Reach;
- 42% of SVOC samples were collected in the Harrison Reach;
- 18% of SVOC samples were collected in the Newark Reach;
- 7% of SVOC samples were collected in the Kearny Reach;
- 16% of SVOC samples were collected in the Upstream Reach.

***For subsurface sediment data:***

- 16% of SVOC samples were collected in the Point No Point Reach;
- 47% of SVOC samples were collected in the Harrison Reach;
- 12% of SVOC samples were collected in the Newark Reach;
- 3% of SVOC samples were collected in the Kearny Reach;
- 16% of SVOC samples were collected in the Upstream Reach.

The following sections provide the following for each subclass of chemicals:

- Introduction – a summary of which (if any) chemicals are selected as COPCs;
- Surficial Sediments – a summary of historical sampling results in surficial sediment;
- Subsurface Sediments – a summary of historical sampling results in subsurface sediment;
- COPC Selection – discussion of which chemicals (if any) were selected as COPCs, why they were selected (or not selected), maps created, background of relevant chemicals, and potential sources of chemicals to the Passaic River;

At the end of this section, discussion of existing data gaps, limitations, and recommendations are provided for further investigation of COPCs as appropriate.

#### **4.4.3.1 Phenolic SVOCs**

##### ***Introduction***

None of the chemicals classified as “Phenolic SVOCs” are retained for consideration as COPCs based on the low frequency of exceedance of available screening guidelines in both surface and subsurface historical sediment samples. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

##### ***Surficial Sediment***

A total of 242 surface sediment samples in the database were analyzed for Phenolic SVOCs. Phenolic SVOC compounds were detected throughout the Passaic River, but were found in less than 5% of the historical samples analyzed for these constituents. From the historical results, three chemicals (2-chlorophenol, 4-nitrophenol, and phenol) were detected for which screening level guidelines are available, and four chemicals (2,4-dichlorophenol, 4-methylphenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol) were detected for which screening level guidelines are not available. Table 4-16 provides a statistical report of historical sampling results for Phenolic SVOCs.

##### **Chemicals with Screening Guidelines**

2-Chlorophenol and 4-nitrophenol each exceeded the screening level guidelines in 0.4% of samples collected. Phenol exceeded the screening level guidelines in 2% of samples collected.



### **Chemicals without Screening Guidelines**

2,4-Dichlorophenol, 4-methylphenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol were detected in 4%, 4%, 2%, and 0.4% of samples collected, respectively.

### ***Subsurface Sediment***

A total of 611 subsurface sediment samples in the database were analyzed for Phenolic SVOCs. Phenolic SVOC compounds were detected throughout the Passaic River, but were found in 5% or fewer of the historical samples analyzed for these constituents. From the historical results, four chemicals (2-chlorophenol, 2,4-dimethylphenol, 2,3,4,5,6-pentachlorophenol, and phenol) were detected for which screening level guidelines are available, and six chemicals (2,4-dichlorophenol, 4,6-dinitro-o-cresol, 2,4-dinitrophenol, 4-methylphenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol) were detected for which screening level guidelines are not available. Table 4-17 provides a statistical report of historical sampling results for Phenolic SVOCs.

### **Chemicals with Screening Guidelines**

2-chlorophenol, 2,4-dimethylphenol, and phenol exceeded the screening level in less than 1% of samples collected, and 2,3,4,5,6-pentachlorophenol did not exceed the screening level in any of the samples collected.

### **Chemicals without Screening Guidelines**

2,4-Dichlorophenol was detected in 5% of samples collected; 4,6-dinitro-o-cresol, 2,4-dinitrophenol, 4-methylphenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol were detected in 1% or fewer of samples collected.

### ***COPC Selection***

Based on available historical data, frequency of exceedance (for chemicals with available screening guidelines), and frequency of detection (for chemicals with no available screening guidelines), no chemicals from the Phenolic SVOCs subclass are

recommended for consideration as COPCs. As a result, mapping was not conducted for any of the Phenolic SVOC chemicals at the surface or subsurface level.

#### **4.4.3.2 Phthalate SVOCs**

##### ***Introduction***

Bis(2-ethylhexyl)phthalate was detected at elevated concentrations in historical surface and subsurface sediment samples. However, based on the ubiquitous nature of this chemical, the consistent concentrations detected throughout the Study Area, and the fact that it is a common laboratory contaminant, bis(2-ethylhexyl)phthalate is not selected as a COPC. No other chemicals classified as “Phthalate SVOCs” are retained for consideration as COPCs based on the low frequency of exceedance of available screening guidelines in both surface and subsurface historical sediment samples. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

##### ***Surface Sediment***

A total of 244 surface sediment samples in the database were analyzed for Phthalate SVOCs. Phthalate SVOC compounds were detected throughout the Passaic River, with detection frequencies between 0-100% for the historical samples analyzed for these constituents. From the historical results, four chemicals [bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate] were detected for which screening level guidelines are available, and two chemicals (dacthal and dimethylphthalate) were detected for which screening level guidelines are not available. Table 4-18 provides a statistical report of historical sampling results for Phthalate SVOCs.

##### **Chemicals with Screening Guidelines**

Bis(2-ethylhexyl)phthalate exceeded the most conservative screening level in 96% of samples collected. However, the historical data are compared to the less stringent 1997 NAWQC Sediment Quality Benchmarks, Marine/Estuarine Chronic Values, bis(2-

ethylhexyl)phthalate exceeds the screening level guideline of 890,000 ppm in less than 1% of samples. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant, and is ubiquitous throughout the environment due to its common use in plastics (ATSDR, 2002). Bis(2-ethylhexyl)phthalate does not dissolve easily in water, and does not break down easily when it has deposited in sediment and soil.

Butyl benzyl phthalate exceeded the screening level in 2% of the samples collected. Di-n-butyl phthalate and di-n-octyl phthalate did not exceed the screening level guidelines.

### **Chemicals without Screening Guidelines**

Dimethylphthalate was detected in 2% of samples collected. Dacthal was detected in 100% of samples collected. Dacthal “is a phthalate pre-emergent herbicide used on annual grasses and annual broadleaf weed species in a wide range of vegetable crops,” (EXTOXNET, 1996). Dacthal is virtually non-degradable in water, and is moderately persistent in soil (half-life is from 14-100 days in most soils), according to EXTOXNET (1996). As such, it would not be expected that dacthal would accumulate in the sediments of the study area. Although dacthal was detected in all of the samples collected, the sample size for this chemical is low (11 samples were collected). Therefore, no conclusions can be drawn about this chemical at this time. In the future, additional sampling may be needed to determine whether dacthal is a COPC for the site.

### ***Subsurface Sediment***

A total of 611 surface sediment samples in the database were analyzed for Phthalate SVOCs. Phthalate SVOC compounds were detected throughout the Passaic River, with detection frequencies between 0-67% for the historical samples analyzed for these constituents. From the historical results, four chemicals were detected [bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate]; screening level guidelines were available for each chemical. Table 4-19 provides a statistical report of historical sampling results for Phthalate SVOCs.

## **Chemicals with Screening Guidelines**

Bis(2-ethylhexyl)phthalate exceeded the screening level in 67% of samples collected. The most conservative sediment screening guideline was used as a default value in this study. When the historical data are compared to the 1997 NAWQC Sediment Quality Benchmarks, Marine/Estuarine Chronic Values, bis(2-ethylhexyl)phthalate exceeds the screening level guideline of 890,000 ppm in less than 1% of samples.

Butyl benzyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate exceeded the screening level in 2%, 4%, and 0.3% of the samples collected, respectively.

### ***COPC Selection***

As discussed above, none of the Phthalate SVOCs were selected as COPCs for the site. As a result, mapping was not conducted for any of the Phthalate SVOC chemicals at the surface or subsurface level. Dacthal may become a COPC in the future; however, due to the lack of data for this chemical, additional information will be needed.

#### **4.4.3.3 Other SVOCs**

##### ***Introduction***

None of the chemicals classified as “Other SVOCs” are retained for consideration as COPCs based on the low frequency of exceedance of available screening guidelines in both surface and subsurface historical sediment samples. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

##### ***Surface Sediment***

A total of 242 surface sediment samples in the database were analyzed for Other SVOCs (i.e., SVOCs that could not be classified as either phenolics, phthalates, or PAHs). Other SVOC compounds were detected throughout the Passaic River, with detection frequencies between 0-100% for the historical samples analyzed for these constituents. From the historical results, three chemicals (m-dichlorobenzene, o-

dichlorobenzene, and 1,2,4-trichlorobenzene) were detected for which screening level guidelines are available, and 10 chemicals (benzo(b)thiophene, carbazole, 4-chloroaniline, dibenzothiophene, N-nitroso-di-phenylamine, pentachloroanisole, monobutyltin, dibutyltin, tributyltin, and tetrabutyltin) were detected for which screening level guidelines are not available. Table 4-20 provides a statistical report of historical sampling results for Other SVOCs.

### **Chemicals with Screening Guidelines**

m-Dichlorobenzene and 1,2,4-trichlorobenzene did not exceed the screening level guidelines. o-Dichlorobenzene exceeded the screening guidelines in 0.4% of the samples collected. Due to these low exceedance frequencies, these chemicals are not considered for inclusion as COPCs.

### **Chemicals without Screening Guidelines**

Sample sizes (marked by “n”) and frequencies of detection (marked by %) for the 10 chemicals without screening guidelines are noted as follows:

- Benzo(b)thiophene: n=7; detection frequency = 64%;
- Carbazole: n= 236; detection frequency = 28%;
- 4-Chloroaniline: n=242; detection frequency = 0.4%;
- Dibenzothiophene: n=84; detection frequency = 98%;
- N-nitroso-di-phenylamine: n=242; detection frequency = 7%;
- Pentachloroanisole: n=9; detection frequency = 100%;
- Monobutyltin: n=95; detection frequency = 49%;
- Dibutyltin: n=95; detection frequency = 84%;
- Tributyltin: n=95; detection frequency = 76%; and
- Tetrabutyltin: n=76; detection frequency = 17%.

### ***Subsurface Sediment***

A total of 611 subsurface sediment samples in the database were analyzed for Other SVOCs. Other SVOC compounds were detected throughout the Passaic River, but were found in 16% or fewer of the historical samples analyzed for these constituents. From the historical results, four chemicals (m-dichlorobenzene, o-dichlorobenzene, hexachlorobutadiene, and 1,2,4-trichlorobenzene) were detected for which screening level guidelines are available, and eight chemicals (carbazole, 4-chloroaniline, 2,4-dinitrotoluene, hexachloroethane, N-nitroso-di-phenylamine, monobutyltin, dibutyltin, and tributyltin) were detected for which screening level guidelines are not available. Table 4-21 provides a statistical report of historical sampling results for Other SVOCs.

### **Chemicals with Screening Guidelines**

m-Dichlorobenzene, o-dichlorobenzene, hexachlorobutadiene, and 1,2,4-trichlorobenzene exceeded the screening level guidelines in 1%, 2%, 0.3%, and 1% of subsurface samples collected, respectively.

### **Chemicals without Screening Guidelines**

Sample sizes (marked by “n”) and frequencies of detection (marked by %) for the 10 chemicals without screening guidelines are noted as follows:

- Carbazole: n= 611; detection frequency = 8%;
- 4-Chloroaniline: n=611; detection frequency = 1%;
- 2,4-Dinitrotoluene: n=611; detection frequency = 1%
- Hexachloroethane: n=611; detection frequency = 0.2%;
- N-nitroso-di-phenylamine: n=611; detection frequency = 1%;
- Monobutyltin: n=45; detection frequency = 16%;
- Dibutyltin: n=45; detection frequency = 13%; and
- Tributyltin: n=45; detection frequency = 3%.

### ***COPC Selection***

#### **Chemicals with Screening Guidelines**

None of the chemicals with screening guidance values were selected as COPCs based on their low frequencies of exceedance in surface and subsurface sediment samples.

#### **Chemicals without Screening Guidelines**

Carbazole, 4-chloroaniline, and n-nitroso-di-phenylamine were not selected as COPCs based on their low detection frequency in surface and subsurface sediment samples. Although benzo(b)thiophene and pentachloroanisole were detected in more than half of the samples collected, the sample sizes for these chemicals are low (7 and 9 samples, respectively). Therefore, no conclusions can be drawn about these chemicals at this time. In the future, additional sampling may be needed to determine whether benzo(b)thiophene and pentachloroanisole are COPCs for the site. Several organotin compounds (monobutyltin, dibutyltin, tributyltin, and tetrabutyltin), which are used in the manufacture of polyvinyl chloride (PVC), were also detected in a majority of the samples collected; however, no information could be found regarding their toxicity in an aquatic environment. An abstract in a Canadian Journal (Water Pollution Research Journal of Canada, 26(3): 243-360, 1991, Aquatic Environmental Aspects of Non-Pesticidal Organotin Compounds, R. James Maguire, Rivers Research Branch, National Water Research Institute, Department of Environment, Canada Centre for Inland Waters, Burlington, Ontario L7R 4A6, Canada) indicated that these organotins do not typically pose threats in riverine systems since they are not persistent and have short half lives. Currently, these compounds will not be considered as COPCs. If additional information becomes available in the future that indicates these compounds are persistent and toxic in an aquatic environment, then their inclusion as COPCs will be re-evaluated.

Mapping was not conducted for any of the Other SVOC chemicals at the surface or subsurface level.

#### **4.4.3.4 TOTAL PAH SVOCs**

At the time of this evaluation, samples were collected and analyzed for PAHs in the following 14 studies contained in PREMIS:

- EPA EMAP 90-92;
- PASSAIC 1990 Surficial Sediment Investigation;
- PASSAIC 1991 Core Sediment Investigation;
- PASSAIC 1992 Core Sediment Investigation;
- NOAA NS&T Hudson-Raritan Phase II, 1993;
- PASSAIC 1993 Core Sediment Investigation - 01 (March);
- PASSAIC 1993 Core Sediment Investigation - 02 (July);
- REMAP, 1994;
- PASSAIC 1994 Surficial Sediment Investigation;
- PASSAIC 1995 USACE Minish Park Investigation;
- PASSAIC 1995 RI Sampling Program;
- PASSAIC 1999 Late Summer/Early Fall ESP Sampling Program;
- PASSAIC 1999/2000 Minish Park Monitoring Program;
- PASSAIC 2000 Spring ESP Sampling Program;

The percentage of samples collected from each reach of the Passaic River was evaluated and is detailed below:



***For surficial sediment data:***

- 17% of PAH samples were collected in the Point No Point Reach;
- 43% of PAH samples were collected in the Harrison Reach;
- 19% of PAH samples were collected in the Newark Reach;
- 7% of PAH samples were collected in the Kearny Reach;
- 13% of PAH samples were collected in the Upstream Reach.

***For subsurface sediment data:***

- 16% of PAH samples were collected in the Point No Point Reach;
- 47% of PAH samples were collected in the Harrison Reach;
- 22% of PAH samples were collected in the Newark Reach;
- 12% of PAH samples were collected in the Kearny Reach;
- 3% of PAH samples were collected in the Upstream Reach.

As discussed earlier, PAHs were evaluated as Total PAHs, HMW PAHs, and LMW PAHs. Historical data sampling results and maps are discussed for each subclass below.

#### **4.4.3.5 Total PAHs**

***Introduction***

Historical data for surface and subsurface sediment are summarized below for Total PAHs. Screening guidelines were only used for HMW PAHs and LMW PAHs, so no comparisons of Total PAHs are made to screening guidelines. PAHs are a group of over 100 different chemicals that are formed during the incomplete combustion of substances such as coal, oil and gas, garbage, or other organic substances such as tobacco and charbroiled meat (ATSDR, 1996b). PAHs were broken into HMW and LMW subclasses because the chemicals within each subclass typically have similar physical and chemical characteristics (e.g., resistance to degradation, solubility, toxicity). As such, HMW PAHs are evaluated as a group of chemicals, and LMW PAHs are evaluated as

another group of chemicals; the individual chemicals that comprise each group are not evaluated in this report. The chemicals contained in each subclass can be seen in Table 4-22.

### ***Surface Sediment***

A total of 330 historical surface sediment samples in the database were analyzed for Total PAHs. As can be seen by this data, PAHs are ubiquitous in the Lower Passaic River. HMW PAHs were detected in 91% of surface samples collected and LMW PAHs were detected in 99% of surface samples collected. Table 4-23 provides a statistical report of historical sampling results for Total PAHs, HMW PAHs, and LMW PAHs.

### ***Subsurface Sediment***

A total of 611 historical subsurface sediment samples in the database were analyzed for Total PAHs. HMW PAHs were detected in 85% of subsurface samples collected. LMW PAHs were detected in 78% of subsurface samples collected. Table 4-24 provides a statistical report of historical sampling results for Total PAHs, HMW PAHs, and LMW PAHs.

### ***COPC Selection***

As discussed above, the HMW PAH and LMW PAH subclasses were evaluated as a group. To determine whether they were COPCs, they were compared to the relevant screening guideline (1997 NOAA Selected Integrative Sediment Quality Benchmarks for Marine and Estuarine Sediments, ER-M values).

#### **4.4.3.6 HMW PAHs**

### ***Introduction***

The HMW PAHs subclass is selected as a COPC based on the frequency of exceedance for this subclass when compared to existing screening guidelines. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

### ***Surface Sediment***

A total of 330 historical surface sediment samples in the database were analyzed for HMW PAHs. HMW PAHs were detected throughout the Passaic River. The sampling results were compared to the 1997 NOAA Selected Integrative Sediment Quality Benchmarks for Marine and Estuarine Sediments, ER-M values. Of the 330 historical samples collected, 88% exceeded the sediment screening guideline of 9,600 ppb. Table 4-23 provides a statistical report of historical sampling results for Total PAHs, HMW PAHs, and LMW PAHs.

A map of surficial sediment analytical results for HMW PAHs is provided as Figure 4-27. This map contains surficial sediment data for the entire 17-mile study area of the Passaic River. The highest concentration (1,400,000 ppb) occurs at River Mile 4.47 (south shore).

### ***Subsurface Sediment***

A total of 611 historical subsurface sediment samples in the database were analyzed for HMW PAHs. Of the 611 samples, 74% exceeded the sediment screening guideline of 9,600 ppb. Table 4-24 provides a statistical report of historical sampling results for Total PAHs, HMW PAHs, and LMW PAHs.

A map of subsurface sediment analytical results for HMW PAHs is provided as Figure 4-28. This map contains subsurface sediment data from River Mile 2.6 to River Mile 4.8 of the Passaic River. The highest concentrations occur on the south shore at River Mile 3.07 (2,290,000 ppb, 1-3 feet) and River Mile 4.05 (1,080,000 ppb, 3-6 feet). These sampling locations are in the vicinity of the former PSE&G Front Street (Newark) Gas Works facility, a manufactured gas plant which operated between approximately 1869 and 1926. According to the PSE&G internet site, over 240,000 tons of contaminated soil were excavated to remediate MGP-related soil and groundwater contamination in order to prevent adverse environmental impacts to the Passaic River (<http://www.pseg.com/environment/urban/remedia.html>, last accessed May 4, 2004). MGP plants typically produce higher levels of HMW PAH byproducts, since HMW PAHs are combustion byproducts. Other potential sources of HMW PAHs include

businesses involved in petroleum processing/distribution, automobile pollution, and other combustion sources.

#### ***COPC Selection***

Based on the frequency of exceedance of available screening guidelines, the HMW PAH subclass is selected as a COPC.

#### **4.4.3.7 LMW PAHs**

##### ***Introduction***

The LMW PAHs subclass is selected as a COPC based on the frequency of exceedance for this subclass when compared to existing screening guidelines. Historical surface and subsurface sediment sampling results for these chemicals are discussed in further detail below.

##### ***Surface Sediment***

A total of 330 historical surface sediment samples in the database were analyzed for HMW PAHs. HMW PAHs were detected throughout the Passaic River. The sampling results were compared to the 1997 NOAA Selected Integrative Sediment Quality Benchmarks for Marine and Estuarine Sediments, ER-M values. Of the 330 historical samples collected, 48% exceeded the sediment screening guideline of 3,160 ppb. Table 4-23 provides a statistical report of historical sampling results for Total PAHs, HMW PAHs, and LMW PAHs.

A map of surficial sediment analytical results for LMW PAHs is provided as Figure 4-29. This map contains surficial sediment data for the entire 17-mile study area of the Passaic River. The highest concentration (1,410,000 ppb) occurs at River Mile 4.47 (south shore). This sample result is from the same sample which contains the highest concentration of HMW PAHs.

##### ***Subsurface Sediment***

A total of 611 historical subsurface sediment samples in the database were analyzed for LMW PAHs. Of the 611 samples, 53% exceeded the sediment screening

guideline of 3,160 ppb. Table 4-24 provides a statistical report of historical sampling results for Total PAHs, HMW PAHs, and LMW PAHs.

A map of subsurface sediment analytical results for HMW PAHs is provided as Figure 4-30. This map contains subsurface sediment data from River Mile 2.6 to River Mile 4.8 of the Passaic River.

The highest concentrations occur along the south shore at River Mile 3.07 (5,460,000 ppb, 1-3 feet) and at River Mile 4.05 (1,230,000 ppb, 3-6 feet). These sample results are from the same samples collected which contain the highest concentrations of HMW PAHs.

#### ***COPC Selection***

Based on the frequency of exceedance of available screening guidelines, the LMW PAH subclass is selected as a COPC.

#### **4.4.4 Data Gaps and Recommendations**

- Only nine historical samples provide data for subsurface sediment data from 0.5-1.0 feet. Future sampling events should include samples within this portion of the sediment to provide further characterization of chemical concentrations in the subsurface sediment.
- The majority of surface and subsurface sediment samples evaluated in this study were collected in the Harrison Reach (42% and 47%, respectively). Future sampling events should include balanced representation of other reaches within the study area.
- Sample sizes for benzo(b)thiophene and pentachloroanisole were low (i.e., less than 10) in surface sediment; no subsurface samples were analyzed for these compounds. If it is determined that these contaminants could have a significant impact on the risk assessment, additional samples should be collected and analyzed.
- Further investigation will be required to determine the source of high PAH concentrations in the surface and subsurface sediments.

## 4.5 PCBs

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### 4.5.1 Preliminary Screening of the PREmis Historical Database for PCBs

#### 4.5.1.1 Introduction

The historical polychlorinated biphenyl (PCB) data contained in PREmis were reviewed to gain an understanding of the coverage of data for the 17-mile stretch of the Passaic River, the range of the contaminant concentrations in the different reaches, and to determine if PCB is a class of COPCs for the Lower Passaic River Restoration Project. PREmis contains data from a large number of studies generated by several government agencies and other organizations. The majority of the data have been generated through various investigations of the 6-mile stretch of the Lower Passaic River in the past 10 years. However, data were reviewed going back to 1990, and the review included data from all five stretches of the river that comprise the 17-mile study area.

The PCB data in the database were reported in a number of different ways by different laboratories and studies. For instance, some laboratories reported concentrations of Aroclor formulations, while others reported concentrations of PCB congeners (the individual compounds that make up a PCB mixture). Some of the data were reported by homologous series (*i.e.*, level of chlorination). In addition, Aroclor data were sometimes reported by Aroclor and sometimes as combinations of Aroclors, and different sets of PCB congeners were reported for different studies. Furthermore, it was not always clear from the chemical description what the data represented. Therefore, this review focused on the samples from relatively large datasets that were consistently reported as Aroclors (this is the form of most of the PCB data in the database). Data were also included for samples that had results for a large set of individual PCB congeners (>50 congeners), and the total PCB was then estimated as the sum of the congeners. Altogether, the database contained 255 surficial sediment samples (defined as those samples collected within the top 6 inches) and 580 subsurface sediment samples with data in this form that were then included for this review (Table 4-25).

**Table 4-25: Number of Samples in the PREmis Database Used to Evaluate the PCB Historical Sediment Data**

Reach	Number of samples used for the PCB data evaluation	
	Surface sediment	Subsurface sediment <sup>a</sup>
Upstream Reach	44	24
Kearny Reach	19	69
Newark Reach	42	114
Harrison Reach	108	277
Point No Point Reach	42	96
Total number:	255	580

<sup>a</sup> Subsurface samples represent sub samples from sediment cores, and not the number of coring locations.

Most of the sample data that were used in this exercise were based on Aroclor analysis. It should be noted that a large number of PCB data in the database were not included in this review because of reporting discrepancies; the type and reliability of data could not easily be verified. More data can likely be included if the data in the database are more thoroughly scrutinized, and if more information is obtained on the data reporting for selected studies.

The historical data were reviewed and summarized to obtain a general understanding of the contaminant concentrations within the 17 mile stretch, based on available data. This included determining the minimum and maximum concentrations detected in the five reaches, the average concentration, and the number of samples and frequency of detections in each reach. The PCB concentrations were also compared against a commonly used sediment quality guideline value as a component of the data assessment. Such summary statistics provide a first-level overview of the contaminant concentrations, and a preliminary review of the geographical distribution of the contamination was performed to better understand the contamination.

A variety of sediment quality guidelines (SQG) values are available to aid the assessment of sediment contamination. The 1998 NJDEP Marine/Estuarine Sediment

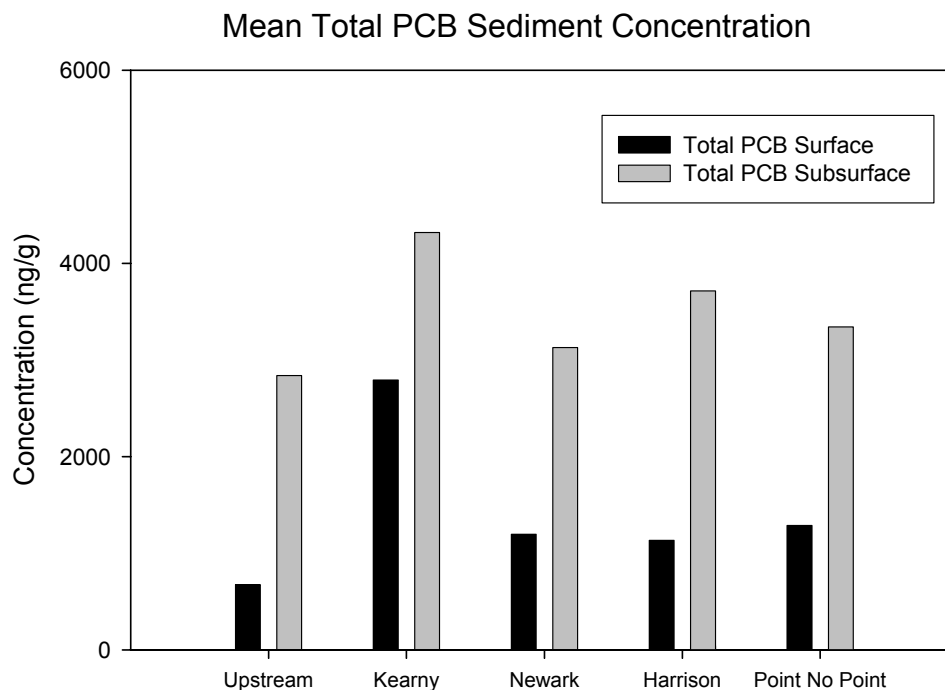
Screening Guidelines ER-M values are often used in New Jersey to evaluate estuarine sediment contamination. The NJDEP screening values are based on Long *et al.*, 1995, and the ER-M value for Total PCB of 180 ng/g was used as part of the data evaluation. If 25% of the samples analyzed for a given reach exceeded the 180 ng/g ER-M value, the contaminant was considered a COPC. However, other factors including the distribution and relative magnitude of the contamination in different parts of the river, and historical contaminant assessments of the area, were also considered. The PCB ER-M value was exceeded for 83% of the surface sediment samples from the investigated area; the exceedance rate ranged from 54% (Upstream Reach) to 100% (Kearny Reach). The surface sediments from the Kearny, Newark, Harrison, and Point no Point reaches all had PCB concentrations with ER-M exceedance rates greater than 80%; PCB is a COPC based on the results from the ER-M SQG evaluation.

#### **4.5.1.2 Preliminary Data Review**

PCBs are widely detected in urban sediments because of their low water solubility, persistence, and wide spread use in our environment. PCBs have been widely used in transformers and capacitors because of their inflammability and favorable electrical properties, but have also been used in a variety of other industrial and commercial applications. The production of PCBs ceased in 1977, but PCB containing materials still exist today; environmental concentrations are slowly declining.

Aroclors (when analyzed) and individual PCB congeners (when analyzed) were widely detected in the sediments of the Lower Passaic River. The compositional characteristics of the PCB in the river sediment could not be readily assessed in this data review, primarily because the data set that was used contained different types of PCB data that could not be directly compared for compositional information. However, the database contains some PCB congener data that can be directly compared for samples from different locations, and interpreted to assess compositional differences and similarities and possible source relationships.





**Figure 31: Average Total PCB concentrations in Surface and Subsurface Sediments from the Five Reaches in the 17-mile Study Area.**

The surface sediment PCB concentrations varied considerably from sample-to-sample, but the mean concentrations for the different reaches were less variable. For instance, the mean Total PCB concentration in the surface sediments ranged from 680 ng/g to 2,800 ng/g for the five reaches. The concentrations were higher and more uniform in the subsurface sediments (Figure 31); the mean subsurface Total PCB concentration ranged from 2,800 ng/g (Upstream Reach) to 4,300 ng/g (Kearny Reach), based on the dataset that was evaluated for this exercise.

The 180 ng/g ER-M SQG value for Total PCB contamination was exceeded in the vast majority of the surface sediment samples; 83% of the surface sediment samples from the 17 mile study area had Total PCB concentrations that exceeded the ER-M. In addition,

higher PCB concentrations were measured in much of the subsurface sediments. Based on these observations, PCBs are considered a COPC for the Lower Passaic River.

#### 4.5.2 Detailed Data Evaluation

The PCB data were further analyzed through basic summary statistics and through mapping of surface and subsurface data points in the river. From these analyses the extent of contamination was identified and, it was possible to also identify data gaps to be considered for future sampling events. The data from a total of 255 surficial sediment samples and 580 subsurface samples were compiled and summarized. The samples were collected from 1990 and on, with the majority being from the mid-1990's.

##### 4.5.2.1 Surficial Sediment

The surface sediment data are summarized in Table 4-26. The surface sediment concentrations are also illustrated for each sample on a map in Figure 4-32.

**Table 4-26: Surface Sediment Total PCB Concentrations, Detection Frequency, and Reference Value Exceedance Frequency Based on PREmis Historical Sediment Data**

Occurrence and Distribution of Chemicals of Potential Concern SEDIMENT: Surface samples CLASS: PCBs							
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency	Reference Value (ppb)	Exceedance Frequency
<i>Total PCB Concentration</i>							
Upstream Reach	180	1,900	NG/G	680	26 / 44	180	25/44 (57%)
Kearny Reach	340	17,000	NG/G	2,800	19 / 19	180	19/19
Newark Reach	77	3,000	NG/G	1,200	37 / 42	180	35/42 (83%)
Harrison Reach	54	10,300	NG/G	1,100	98 / 108	180	92/108
Point No Point	350	6,000	NG/G	1,300	41 / 42	180	41/42 (98%)

The highest PCB concentrations were measured in the Kearny Reach, followed by the Harrison, Point No Point, and Newark reaches, which had relatively similar surface sediment total PCB concentrations. The PCB concentrations were generally lower in the

Upstream Reach. However, there are only a limited number of samples from the Kearny Reach, and it is therefore unclear how representative these data are for this reach. Furthermore, the average concentrations were approximately within a factor of four for all reaches and approximately within a factor of two for the four down-estuary reaches; on a mean concentration basis the surface sediment levels were relatively similar, particularly in the main 6-mile study area. The PCB concentrations in the surficial sediment samples exceeded the ER-M value in 212 of the 255 samples; 83% of all the samples had Total PCB concentrations that exceeded the ER-M, and 89% of the samples from the four down-estuary reaches exceeded the ER-M. As illustrated in Figure 4-32, the samples with the highest concentrations were collected in the Kearny, Newark, Harrison, and Point no Point Reaches from River Miles (RM) 1 to 7. Five samples in this area had Total PCB concentrations above 5,000 ng/g.

#### 4.5.2.2 Subsurface Sediment

The subsurface Total PCB sediment data are summarized in Table 4-27. The subsurface sediment concentrations are also illustrated on maps in Figure 4-33 for the samples from RM 1 to RM 6; this is the part of the river with the highest subsurface sample density, and also where many of the highest subsurface PCB concentrations have been measured.

**Table 4-27: Subsurface Sediment Total PCB Concentrations and Detection Frequency Based on PREmis Historical Sediment Data**

Occurrence and Distribution of Chemicals of Potential Concern SEDIMENT: Subsurface samples CLASS: PCBs					
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency
<b>Total PCB Concentration</b>					
Upstream Reach	180	7,800	NG/G	2,800	10/24
Kearny Reach	340	19,000	NG/G	4,300	47/69
Newark Reach	45	34,000	NG/G	3,100	62/114
Harrison Reach	97	48,000	NG/G	3,700	158/277
Point No Point	240	29,000	NG/G	3,300	74/96

The mean subsurface Total PCB concentrations were generally two to three times higher than the surface sediment concentrations; it was about four times higher for the Upstream Reach. The mean subsurface Total PCB concentrations were quite similar for the five reaches; they were all within a factor of two of each other, ranging from 2,800 ng/g (Upstream reach) to 4,300 ng/g (Kearny Reach). The highest individual sample Total PCB concentration was measured in the Harrison Reach (34,000 ng/g), but samples the Kearny, Newark, and Point No Point reaches also had samples with Total PCB concentrations greater than 10,000 ng/g.

The PCB concentrations were widely elevated in the Lower Passaic River surface sediments, based on an assessment relative to the ER-M SQG value. The highest surface sediment PCB concentrations were measured in sediments from RM 1 to RM 7. The subsurface sediment from a depth between 1 to 6 feet generally had higher PCB concentrations than the surface sediments, and high concentrations were also measured in samples from a depth of more than 6 feet. The highest PCB concentrations in this Passaic River dataset were for samples collected at a depth of several feet, and high concentrations were measured at several locations in several reaches; there were no one or two obvious “hot spot”. These data suggest that notable levels of PCB continue to be released to the Lower Passaic River, but that somewhat less enters the river today than historically.

#### **4.5.3 Data Gaps**

The following data gaps were identified as a result of this evaluation of the PCB data.

- There is little to no data for the 0.5 to 1 foot interval.
- Subsurface mapping indicates that there are elevated PCB concentrations even at the greatest sampling depth in some locations. Additional sampling is needed to determine the vertical extend of the elevated concentrations.
- Elevated PCB concentrations, relative to the ER-M, were measured at several distant surface and subsurface locations in the Lower Passaic River. Additional data analysis and/or sampling are needed to fully characterize the location and distribution of the most contaminated sediments.

#### **4.5.4 Recommendations for Additional Evaluation**

The following recommendations for additional evaluation were identified as a result of this review of historical data.

- Additional sampling should be conducted to obtain information for the poorly characterized 0.5 to 1 foot interval.
- Subsurface mapping indicates that there are elevated PCB concentrations even at the greatest sampling depth in some locations. Deep (below 6 feet) subsurface sediment samples should be collected at key locations, to determine the vertical extent of the PCB contamination and the depth at which there no longer is notable contamination.
- Additional data analysis, including the use of total organic carbon and grain size data, is needed to better understand the distribution of the PCB contamination, including accumulation in organic rich sediments and depositional environments. This may need to be complemented with additional sampling to fully characterize the location and distribution of the most contaminated sediments.

### **4.6 DIOXIN/FURAN**

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#### **4.6.1 Preliminary Screening of the PREmis Historical Database for Dioxin/Furan**

##### **4.6.1.1 Introduction**

The historical dioxin and furan data contained in PREmis were reviewed to gain an understanding of the coverage of data for the 17-mile stretch of the Passaic River, the range of the contaminant concentrations in the different reaches, and to determine if dioxin/furan is a class of potential concern for the Lower Passaic River Restoration Project. PREmis contains data from a large number of studies generated by several government agencies and other organizations. The majority of the data have been generated through various investigations of the 6-mile stretch of the Lower Passaic River in the past 10 years. However, data were reviewed going back to 1990, and the review included data from all five stretches of the river that comprise the 17-mile study area.

The dioxin and furan data in the database were reported in a number of different ways by different laboratories and studies; it was not always clear from the chemical description what the data represented. Therefore, this review focused on the samples for which all 17 dioxin and furan congeners, or just 2,3,7,8-TCDD, was clearly identified and determined in the analysis. Altogether, the database contained 267 surficial sediment samples (defined as those samples collected within the top 6 inches) and 598 subsurface sediment samples with data included for this review (Table 4-28). These samples were analyzed for either just the 2,3,7,8-TCDD dioxin congener, or all 17 commonly assessed tetra- to octa-substituted dioxin and furan congeners. Most samples were analyzed for all 17 congeners.

**Table 4-28: Number of Samples in the PREmis Database Used to Evaluate the Dioxin/Furan Historical Sediment Data**

Reach	Number of samples used for the dioxin/furan data evaluation	
	Surface sediment	Subsurface sediment <sup>a</sup>
Upstream Reach	46	24
Kearny Reach	19	71
Newark Reach	45	120
Harrison Reach	114	286
Point No Point Reach	43	97
Total number:	267	598

<sup>a</sup> Subsurface samples represent subsamples from sediment cores, and not the number of coring locations.

The historical data were reviewed and summarized to obtain a general understanding of the contaminant concentrations within the 17 mile stretch of the tidal Passaic River. This included determining the minimum and maximum concentrations detected in the five reaches, the average concentration, and the number frequency of detections in each reach. Such summary statistics provide a first-level overview of the contaminant concentrations, and a preliminary review of the geographical distribution of the contamination was performed to better understand the contamination.

A variety of sediment quality guidelines are available to aid the assessment of sediment contamination. The 1998 NJDEP Marine/Estuarine Sediment Screening Guidelines ER-M values are often used in New Jersey to assess the potential of estuarine sediment contamination to cause harm to benthic organisms. However, there are no ER-M values for dioxin/furans. ER-M, and other guidelines that focus on potential effects on benthic organisms, may not be useful for assessing the relevance of dioxin/furan contamination, because benthic organisms are relatively insensitive to dioxin/furan. However, dioxin/furan has a relatively high potential to bioaccumulate if released from the sediment, and may concentrate in other components of the ecosystem that may be sensitive to dioxin/furan contamination (*e.g.*, birds and humans). It may therefore be more appropriate to base the assessment of the dioxin/furan sediment contamination on an equilibrium partitioning approach (DiToro *et al.*, 1991; EPA, 2003), in combination with determining the potential of the contamination released from the sediment to bioaccumulate in key biological organisms, followed by a comparison of the estimated biological concentrations to biological toxic equivalency quotient (TEQ) benchmark values. Direct evaluations of measured biological tissue concentration can also help to determine the significance of the dioxin/furan concentrations in the area. Such an assessment of the bioaccumulation potential was beyond the scope of this review.

The sediment dioxin/furan concentrations were instead compared to a 1 ngTEQ/g reference value, with the TEQ being the 2,3,7,8-TCDD TEQ based on the data for all 17 dioxin/furan congeners and the application of the human/mammalian toxic equivalency factors (TEF) published by the World Health Organization (1997). The 1 ngTEQ/g concentration is sometimes used as an action level for contaminated soils and sediments, and is based on the USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-26 (*Approaches for Addressing Dioxins in Soil at CERCLA and RCRA Sites*, April 13, 1998). However, it is recognized that the 1 ngTEQ/g may not be sufficiently protective of all important biota and all contaminated sediment locations, and should only used as one component of an assessment of the contamination.

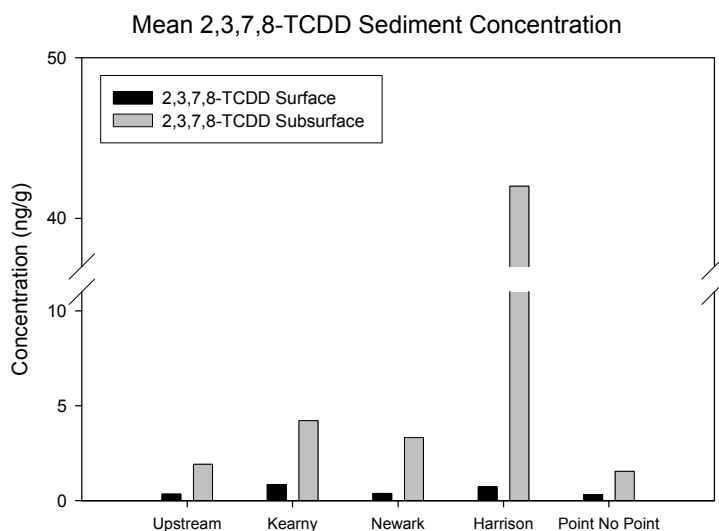
If 25% of the samples analyzed for a given reach exceeded the 1 ngTEQ/g reference value, the contaminant would be considered a COPC. However, if less than 25% exceeded the reference value this did not necessarily mean that it would not be considered a COPC; the distribution of the contamination, historical contaminant assessments of the area, and the uncertainty in the applicability of the 1 ngTEQ/g reference value as an assessment guideline value were also considered.

#### **4.6.1.2 Preliminary Data Review**

Dioxin and furan compounds are widely detected in urban sediments, and are often attributed to incineration and other combustion activities. Dioxin and furans have also been produced and released as impurities and waste products from various chemical production activities, including the production of chlorinated pesticides and herbicides produced at the Diamond Alkali Superfund Site (about River Mile 3.2).

Most of the 17 dioxin and furan were detected in the majority of the study area surface and subsurface sediment samples. The octa-substituted congeners (OCDD and OCDF) were consistently most abundant, generally followed by the two 1,2,3,4,6,7,8-hepta-substituted congeners (1,2,3,4,6,7,8-HpCDF and 1,2,3,4,6,7,8-HpCDD); the next most abundant congener was generally 2,3,7,8-TCDD, which is widely considered to be the dioxin/furan congener of greatest environmental concern. The TEQ value was generally dominated by the contribution from 2,3,7,8-TCDD.





**Figure 4-34: Average 2,3,7,8-TCDD Concentrations in Surface and Subsurface Sediments from the Five Reaches in the 17-mile Study Area.**

The surface sediment dioxin and furan concentrations varied considerably from sample-to-sample, but the mean concentrations for the different reaches were less variable. For instance, the mean 2,3,7,8-TCDD concentration ranged from 0.32 ng/g to 0.84 ng/g for the five reaches. The concentrations were higher and more variable in the subsurface sediments (Figure 4-34); the mean subsurface 2,3,7,8-TCDD concentration ranged from 1.5 ng/g (Point No Point Reach) to 42 ng/g (Harrison Reach), based on the dataset that was evaluated for this exercise.

The 1 ngTEQ/g reference value for dioxin/furan contamination was exceeded in between 1 (Newark Reach) and 11 (Harrison Reach) surface sediment samples. Although the 1 ngTEQ/g was not exceeded in more than 25% of the samples, the mean TEQ was within a factor of 3 for all reaches, and ranged from 0.38 ngTEQ/g to 0.92 ngTEQ/g, and individual sampling locations had concentrations as high as 14 ngTEQ/g (a location along the south shore in the Harrison Reach). In addition, significantly higher dioxin and furan concentrations were measured in some of the subsurface sediments than in surface sediments (the 1 ngTEQ/g exceedance rate has not been determined for the

subsurface sediments). Furthermore, and as discussed earlier, the 1 ngTEQ/g may not be sufficiently protective of Lower Passaic River ecosystem, and human health. Based on the observations made in this review of the historical data, dioxin/furans are considered a COPC for the Lower Passaic River.

#### **4.6.2 Detailed Data Evaluation**

The dioxin and furan data were further analyzed through basic summary statistics and through mapping surface and subsurface data points in the river. From these analyses the extent of contamination was identified. It was also possible to identify data gaps to be considered for future sampling events. The data from a total of 267 surficial sediment samples and 598 subsurface samples were compiled and summarized. The samples were collected from 1990 and on, with the majority being from the mid-1990's.

##### **4.6.2.1 Surficial Sediment**

The surface sediment data are summarized in Table 4-29. The surface sediment concentrations are also illustrated for each sample on maps in Figure 4-35 (2,3,7,8-TCDD concentration) and Figure 4-36 (TEQ concentration).

**Table 4-29: Surface Sediment 2,3,7,8-TCDD and TEQ Concentrations, Detection Frequency, and Reference Value Exceedance Frequency Based on PREMIS Historical Sediment Data**

Occurrence and Distribution of Chemicals of Potential Concern SEDIMENT: Surface samples CLASS: Dioxins							
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency	Reference Value (ppb TEQ)	Exceedance Frequency
<b>2,3,7,8-TCDD Concentration</b>							
Upstream Reach	0.0024	2.0	NG/G	0.34	42/46		
Kearny Reach	0.080	7.0	NG/G	0.84	19/19		
Newark Reach	0.0035	6.0	NG/G	0.37	42/44		
Harrison Reach	0.0020	14	NG/G	0.72	114/114		
Point No Point	0.082	2.0	NG/G	0.32	43/43		
<b>TEQ Concentration</b>							
Upstream Reach	0.0019	1.7	TEQ	0.38	45/45	1	2/45
Kearny Reach	0.093	6.8	TEQ	0.92	19/19	1	3/19
Newark Reach	0.0025	5.7	TEQ	0.40	42/43	1	1/43
Harrison Reach	0.0022	14	TEQ	0.84	112/112	1	11/112
Point No Point	0.097	4.3	TEQ	0.52	43/43	1	3/43

The highest dioxin concentrations were measured in the Harrison Reach and Kearny Reach, and the mean concentrations were quite similar for these two reaches. However, there are only a limited number of samples from the Kearny Reach, and it is therefore unclear how representative these data are for this reach. Furthermore, the average concentrations were within a factor of three for all reaches; on a mean concentration basis the surface sediment levels were relatively similar. The dioxin/furan concentrations in the surficial sediment samples exceeded the reference value of 1 ng TEQ/g in 20 of the 262 samples that were characterized for the full suite of 17 dioxin/furan congeners and could therefore have the TEQ determined. As illustrated in Figures 4-35 and 4-36, the samples with the highest concentrations were collected in the Harrison Reach highest between River Miles (RM) 2.5-4.5. Three samples in this area had 2,3,7,8-TCDD concentrations above 7 ng/g, and four samples had TEQ

concentrations above 7 ng TEQ/g; the maximum concentration was 14 ng/g and 14 ng TEQ/g (2,3,7,8-TCDD was responsible for essentially all of the TEQ in the highest concentration samples, and most of the TEQ in the remaining samples).

#### 4.6.2.2 Subsurface Sediment

The subsurface 2,3,7,8-TCDD sediment data are summarized in Table 4-30. The subsurface sediment concentrations are also illustrated for the samples from RM 1.5 to RM 5.5 on maps in Figure 4-37 (2,3,7,8-TCDD concentration) and Figure 4-38 (TEQ concentration); this is the part of the river with the highest subsurface sample density, and also where the highest subsurface dioxin/furan concentrations have been measured.

**Table 4-30: Subsurface Sediment 2,3,7,8-TCDD Concentrations and Detection Frequency Based on PREmis Historical Sediment Data**

Occurrence and Distribution of Chemicals of Potential Concern SEDIMENT: Subsurface samples CLASS: Dioxins					
Reach	Minimum Conc.	Maximum Conc.	Units	Average Conc.	Detection Frequency
<b>2,3,7,8-TCDD Concentration</b>					
Upstream Reach	0.00044	32	NG/G	1.91	22/24
Kearny Reach	0.0021	27	NG/G	4.21	64/71
Newark Reach	0.00076	58	NG/G	3.32	92/120
Harrison Reach	0.00077	5,300	NG/G	42	250/286
Point No Point	0.000072	18	NG/G	1.54	96/97

The highest subsurface dioxin concentrations were measured in the Harrison Reach, with mean 2,3,7,8-TCDD concentrations that were approximately 10 times higher than the reach with the next highest concentration (Kearny Reach). The mean subsurface 2,3,7,8-TCDD concentrations in the Upstream, Kearny, Newark, and Point No Point reaches were within a factor of three of each other.

The high mean 2,3,7,8-TCDD concentration in the Harrison Reach was greatly influenced by the very high concentrations measured in a few samples. Three of the subsurface sediment samples had 2,3,7,8-TCDD concentrations above 100 ng/g, and two

of the samples collected at a depth of 3'-6' had concentrations above 1,000 ng/g; the highest concentration measured was 5,300 ng/g 2,3,7,8-TCDD. The highest dioxin/furan concentrations in this Passaic River dataset were for samples collected at a depth of several feet, and at a location along the southern shore in the Harrison reach, at approximately RM 3.2; this is near the former Diamond Alkali facility. The subsurface sediments at certain depths at this location appear to have very high dioxin/furan concentrations (in excess of 1,000 ng/g in some places), and the subsurface sediments have notably higher dioxin/furan concentrations than the surface sediments for much of the river. The 2,3,7,8-TCDD concentrations were above 10 ng/g for a large numbers of samples collected in several reaches from a sediment depth of more than 1 foot. These data suggest that there is less dioxin/furan released to the Passaic River today than historically.

#### **4.6.3 Data Gaps**

The following data gaps were identified as a result of this evaluation of the dioxin/furan data.

- There is little to no data for the 0.5 to 1 foot interval.
- Subsurface mapping indicates that there are elevated dioxin/furan concentrations even at the greatest sampling depth in some locations. Additional sampling is needed to determine the vertical extend of the elevated concentrations.
- Highly elevated dioxin/furan concentrations were measured in a few surface and subsurface locations in the Harrison Reach. Additional sampling, and three-dimensional analysis of the data, is needed to fully characterize the location and distribution of the most contaminated sediments.
- The dioxin/furan concentrations appear to be elevated in parts of the Kearny Reach and the lower part of the Upstream Reach; between RM 6 and RM 8. However, this is based on a limited number of samples, and additional sampling is needed to better understand the contaminant levels in this area.

#### **4.6.4 Recommendations for Additional Evaluation**

The following recommendations for additional evaluation were identified as a result of this review of historical data.

- Additional sampling should be conducted to obtain information for the poorly characterized 0.5-1 foot interval.
- Subsurface mapping indicates that there are elevated dioxin/furan concentrations even at the greatest sampling depth in some locations. Additional sampling is needed to determine the vertical extent of the elevated concentrations.
- Deep (below 6 feet) subsurface sediment samples should be collected at key locations, to determine the vertical extent of the high dioxin contamination and the depth at which there no longer is notable contamination.
- Additional sampling is needed to fully characterize the location and distribution of the most contaminated sediments in the Harrison Reach.
- The dioxin/furan concentrations appear to be elevated in parts of the Kearny Reach and the lower part of the Upstream Reach; between RM 6 and RM 8. However, this is based on a limited number of samples, and additional sampling is needed to better understand the contaminant levels in this area.

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## 6.0 GLOSSARY AND ACRONYM

### GLOSSARY AND ACRONYM

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ARAR	Applicable or Relevant and Appropriate Requirements
CARP	Contaminant Assessment Reduction Project
CLH	Chemical Land Holdings Inc
CLP	Contract Laboratory Program
COPC	Chemicals of Primary Concern
CSO	Combined Sewer Overflow
DDT	4,4'-dichlorodiphenyltrichloroethane
DL	Detection limit
DO	Dissolved Oxygen
EMAP	Environmental Monitoring and Assessment Program
F	Fahrenheit
HEP	Harbor Estuary Program
MDL	Method detection limit
MLW	Mean Low Water
MOU	Memorandum of Understanding
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NYCOE	New York Corps of Engineers
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OCC	Occidental Chemical Company
OMR/NJDOT	New Jersey Department of Transportation
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
PMP	Project Management Plan
PREmis	Passaic River Estuary Management Information System
PRSA	Passaic River Study Area
QC	Quality control
REMAP	Regional Environmental Monitoring and Assessment Program
RI/FS	Remedial Investigation and Feasibility Study
TAMS	TAMS/EarthTech, Inc
TEPH	Total Extractable Petroleum Hydrocarbons
TSI	Tierra Solutions Inc
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Services

Table 1-1: Summary of CSOs in the Passaic River

CSO #	Name	Location	Owner	Status		LATITUDE		LONGITUDE	RECEIVING WATERBODY
1	Curtis Place	Paterson	Paterson	Active	N	40.91955744	W	-74.17605623	PASSAIC RIVER
2	Mulberry Street	Paterson	Paterson	Active	N	40.92011366	W	-74.17540063	PASSAIC RIVER
3	West Broadway	Paterson	Paterson	Active	N	40.92078742	W	-74.17480113	PASSAIC RIVER
4	Bank Street	Paterson	Paterson	Active	N	40.92131086	W	-74.17425219	PASSAIC RIVER
5	Bridge Street	Paterson	Paterson	Active	N	40.92307858	W	-74.16987565	PASSAIC RIVER
6	Montgomery Street	Paterson	Paterson	Active	N	40.92504566	W	-74.1668825	PASSAIC RIVER
7	Straight Street	Paterson	Paterson	Active	N	40.92612198	W	-74.16577762	PASSAIC RIVER
8	Franklin Street	Paterson	Paterson	Active	N	40.92649528	W	-74.16542827	PASSAIC RIVER
9	Keen Street	Paterson	Paterson	Active	N	40.92724333	W	-74.16501875	PASSAIC RIVER
10	Warren Street	Paterson	Paterson	Active	N	40.9279176	W	-74.16486462	PASSAIC RIVER
11	Sixth Avenue	Paterson	Paterson	Active	N	40.93424146	W	-74.16642248	PASSAIC RIVER
13	E. 11th Street	Paterson	Paterson	Active	N	40.93698444	W	-74.1569832	PASSAIC RIVER
14	Fourth Avenue	Paterson	Paterson	Active	N	40.93723503	W	-74.15574227	PASSAIC RIVER
15	S.U.M. Park	Paterson	Paterson	Active	N	40.91766503	W	-74.1797415	PASSAIC RIVER
16	Northwest Street	Paterson	Paterson	Active	N	40.92139141	W	-74.17539027	PASSAIC RIVER
17	Arch Street	Paterson	Paterson	Active	N	40.92334229	W	-74.17012051	PASSAIC RIVER
21	Bergen Street	Paterson	Paterson	Active	N	40.92904461	W	-74.16514483	PASSAIC RIVER
22	Short Street	Paterson	Paterson	Active	N	40.93101362	W	-74.16680416	PASSAIC RIVER
23	Second Avenue	Paterson	Paterson	Active	N	40.93849243	W	-74.14280616	PASSAIC RIVER
24	Third Avenue	Paterson	Paterson	Active	N	40.93637785	W	-74.14104983	PASSAIC RIVER
25	33rd Street & 10th Avenue	Paterson	Paterson	Active	N	40.9239142	W	-74.14047266	PASSAIC RIVER
26	20th Avenue	Paterson	Paterson	Active	N	40.90545931	W	-74.13224861	PASSAIC RIVER
27	Market Street	Paterson	Paterson	Active	N	40.90239889	W	-74.13407241	PASSAIC RIVER
67	Hudson Street	Paterson	Paterson	Active	N	40.92497747	W	-74.16826962	PASSAIC RIVER
28	Stewart Avenue	Kearny	Kearny	Active	N	40.77896986	W	-74.14772199	PASSAIC RIVER
29	Washington Avenue	Kearny	Kearny	Active	N	40.77677024	W	-74.14918854	PASSAIC RIVER
31	Nairn Avenue	Kearny	Kearny	Active	N	40.75896229	W	-74.16269243	PASSAIC RIVER
32	Marshall Street	Kearny	Kearny	Active	N	40.75603734	W	-74.16351313	PASSAIC RIVER
33	Johnston Avenue	Kearny	Kearny	Active	N	40.75423926	W	-74.16393242	PASSAIC RIVER
34	Ivy Street	Kearny	Kearny	Active	N	40.76176767	W	-74.14039016	FRANK'S CREEK
37	Duke Street	Kearny	Kearny	Active	N	40.75233594	W	-74.13981581	FRANK'S CREEK
38	Central Avenue	East Newark	East Newark	Active	N	40.75097986	W	-74.16466396	PASSAIC RIVER
39	New Street	Harrison	Harrison	Active	N	40.74734431	W	-74.16510358	PASSAIC RIVER
40	Cleveland Street	Harrison	Harrison	Active	N	40.74595681	W	-74.16512276	PASSAIC RIVER
41	Harrison Avenue	Harrison	Harrison	Active	N	40.74516906	W	-74.16508007	PASSAIC RIVER
42	Dey Street	Harrison	Harrison	Active	N	40.74392541	W	-74.16460475	PASSAIC RIVER
43	Bergen Street	Harrison	Harrison	Active	N	40.74290808	W	-74.16417641	PASSAIC RIVER
44	Middlesex Street	Harrison	Harrison	Active	N	40.74060601	W	-74.16316868	PASSAIC RIVER
45	Worthington Avenue	Harrison	Harrison	Active	N	40.73960351	W	-74.14422336	PASSAIC RIVER
46	Verona Avenue	Newark	Newark	Active	N	40.77651771	W	-74.15121519	PASSAIC RIVER
47	Delavan Avenue	Newark	Newark	Active	N	40.76856688	W	-74.15723593	PASSAIC RIVER
48	Herbert Place	Newark	Newark	Active	N	40.76528267	W	-74.15930066	PASSAIC RIVER

Table 1-1: Summary of CSOs in the Passaic River

CSO #	Name	Location	Owner	Status		LATITUDE		LONGITUDE	RECEIVING WATERBODY
50	Fourth Avenue	Newark	Newark	Active	N	40.75616158	W	-74.16499307	PASSAIC RIVER
51	Clay Street	Newark	Newark	Active	N	40.75098545	W	-74.16579839	PASSAIC RIVER
76	Passaic Street	Newark	Newark	Active	N	40.75098545	W	-74.16579839	PASSAIC RIVER
77	Ogden Street	Newark	Newark	Active	N	40.75098545	W	-74.16579839	PASSAIC RIVER
54	Rector Street	Newark	Newark	Active	N	40.74114583	W	-74.16498813	PASSAIC RIVER
55	Saybrook Place	Newark	Newark	Active	N	40.74069462	W	-74.16474564	PASSAIC RIVER
56	City Dock	Newark	Newark	Active	N	40.73542444	W	-74.16189875	PASSAIC RIVER
57	Jackson Street	Newark	Newark	Active	N	40.73312292	W	-74.15501819	PASSAIC RIVER
58	Polk Street	Newark	Newark	Active	N	40.73311271	W	-74.15413036	PASSAIC RIVER
59	Freeman Street	Newark	Newark	Active	N	40.73406639	W	-74.14573431	PASSAIC RIVER
60	Peddie Street	Newark	Newark	Active	N	40.71070986	W	-74.18648354	PEDDIE DITCH
61	Queens District	Newark	Newark	Active	N	40.70635743	W	-74.18603914	QUEEN DITCH
62	Waverly District	Newark	Newark	Active	N	40.69047792	W	-74.19106382	WAVERLY DITCH
63	Yantacaw Pump Station	Clifton	PVSC	Relief Point	N	40.82137	W	-74.13047928	THIRD RIVER
64	Yantacaw Street	Clifton	PVSC	Relief Point	N	40.82159556	W	-74.13057626	THIRD RIVER
65	Wallington Pump Station	Wallington	PVSC	Relief Point	N	40.85754361	W	-74.11967586	PASSAIC RIVER
66	N. Arlington Branch	North Arlington	PVSC	Relief Point	N	40.78732424	W	-74.14613403	PASSAIC RIVER
69	Lodi Force Main	Passaic	PVSC	Relief Point	N	40.85698944	W	-74.11997697	PASSAIC RIVER
70	Passaic Tail Race	Passaic	PVSC	Relief Point	N	40.85762611	W	-74.11982333	PASSAIC RIVER
75	2nd River Joint Meeting	Newark	PVSC	Relief Point	N	40.77692778	W	-74.15071787	PASSAIC RIVER
001	Meadowbrook	Newark	Newark	Active	N	40.7872817	W	-74.17067965	Second River
006	Oriental	Newark	Newark	Active	N	40.76054118	W	-74.11888586	Passaic River
022	Roanoke	Newark	Newark	Active	N	40.72621861	W	-74.12096986	Newark Bay
023	Adams	Newark	Newark	Active	N	40.71198924	W	-74.16860515	Adams Ditch
024 & 030	Wheeler / Avenue A	Newark	Newark	Active	N	40.71295792	W	-74.18023238	Wheeler Ditch
	Newark Airport Peripheral Ditch	Newark	Newark		N	40.68818813	W	-74.15972907	Flows into Elizabeth Channel
028	Sum Park 2	Paterson	Paterson	Active	N	40.91729174	W	-74.18009014	PASSAIC RIVER
029	Loop Road	Paterson	Paterson	Active	N	40.92212059	W	-74.17215995	PASSAIC RIVER
030	19th Avenue	Paterson	Paterson	Active	N	40.90737302	W	-74.13247222	PASSAIC RIVER
031	Route 20 Bypass	Paterson	Paterson	Active	N	40.90138723	W	-74.13438519	PASSAIC RIVER

Table 3-1: Constituents of Chemical Groups in PREmis Database

CONVENTIONAL	METALS
% Clay	ALUMINUM
% Course Sand	ANTIMONY
% Fine Sand	Arsenic
%Gravel	BARIUM
% Medium Sand	BERYLLIUM
%Sand	Cadmium
%Silt	CALCIUM
%Solids	Chromium
%Fines	COBALT
wet density	Copper
dry density	CYANIDE
liquid limit	IRON
plastic index	Lead
phi angle	MAGNESIUM
staged unconsolidated undrained triaxial	MANGANESE
	Mercury
	Nickel
	POTASSIUM
	SELENIUM
	SILICON
	Silver
	SODIUM
	Thallium
	TIN
	Titanium
	VANADIUM
	Zinc
	Simultaneously extracted metals

Table 3-1: Constituents of Chemical Groups in PREmis Database

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)	
1,6,7-Trimethylnaphthalene	
1-Methylnaphthalene	
1-Methylphenanthrene	
2,3,5-Trimethylnaphthalene	
2,6-Dimethylnaphthalene	
2-Methylnaphthalene	
Acenaphthene	
Acenaphthene d-10	
Acenaphthylene	
Anthracene	
Benz[a]anthracene	
Benzo[a]pyrene	
Benzo[b]fluoranthene	
Benzo[e]pyrene	
Benzo[g,h,i]perylene	
Benzo[k]fluoranthene	
Benzo[flouranthenes, total	
biphenyl	
Chrysene	
Chrysene d-12	
Dibenz[a,h]anthracene	
Dibenz[ah]anthracene d-14	
Fluoranthene	
Fluorene	
Indeno[1,2,3-c,d]-pyrene	
Naphthalene	
Naphthalene d-8	
Perylene	
Phenanthrene	
Pyrene	
Low molecular weight PAHs, total	
High molecular weight PAHs, total	
Total PAH	



Table 3-1: Constituents of Chemical Groups in PREmis Database

POLYCHLORINATED BIPHENYLS (PCBs)		
2-chlorobiphenyl	2,3',5,5'-tetrachlorobiphenyl	2,3,3',4,4',6-hexachlorobiphenyl
3-chlorobiphenyl	2,4,4',5-tetrachlorobiphenyl	2,3,3',4,5,6-hexachlorobiphenyl
4-chlorobiphenyl	2,4,4',6-tetrachlorobiphenyl	2,3,3',5,5',6-hexachlorobiphenyl
2,2'-dichlorobiphenyl	3,3',4,4'-tetrachlorobiphenyl	2,3',4,4',5,5'-hexachlorobiphenyl
2,3'-dichlorobiphenyl	3,4,4',5-tetrachlorobiphenyl	2,3',4,4',5',6-hexachlorobiphenyl
2,3-dichlorobiphenyl	2,2',3,3',4-pentachlorobiphenyl	3,3',4,4',5,5'-hexachlorobiphenyl
2,4'-dichlorobiphenyl	2,2',3,3',5-pentachlorobiphenyl	2,2',3,3',4,4',5-heptachlorobiphenyl
2,4-dichlorobiphenyl	2,2',3,3',6-pentachlorobiphenyl	2,2',3,3',4,4',6-heptachlorobiphenyl
2,5-dichlorobiphenyl	2,2',3,4,4'-pentachlorobiphenyl	2,2',3,3',4,5,5'-heptachlorobiphenyl
2,6-dichlorobiphenyl	2,2',3',4,5-pentachlorobiphenyl	2,2',3,3',4',5,6-heptachlorobiphenyl
3,4-dichlorobiphenyl	2,2',3,4,5'-pentachlorobiphenyl	2,2',3,3',4,5',6-heptachlorobiphenyl
4,4'-dichlorobiphenyl	2,2',3,4,6-pentachlorobiphenyl	2,2',3,3',4,5,6'-heptachlorobiphenyl
2,2',3-trichlorobiphenyl	2,2',3,4',6-pentachlorobiphenyl	2,2',3,3',4,6,6'-heptachlorobiphenyl
2,2',4-trichlorobiphenyl	2,2',3,5,5'-pentachlorobiphenyl	2,2',3,3',5,5',6-heptachlorobiphenyl
2,2',5-trichlorobiphenyl	2,2',3,5',6-pentachlorobiphenyl	2,2',3,3',5,6,6'-heptachlorobiphenyl
2,2',6-trichlorobiphenyl	2,2',3,6,6'-pentachlorobiphenyl	2,2',3,4,4',5,5'-heptachlorobiphenyl
2,3,3'-trichlorobiphenyl	2,2',4,4',5-pentachlorobiphenyl	2,2',3,4,4',5',6-heptachlorobiphenyl
2,3,4'-trichlorobiphenyl	2,2',4,5,5'-pentachlorobiphenyl	2,2',3,4,4',5,6'-heptachlorobiphenyl
2,3,4-trichlorobiphenyl	2,3,3',4,4'-pentachlorobiphenyl	2,2',3,4,4',6,6'-heptachlorobiphenyl
2',3,4-trichlorobiphenyl	2',3,3',4,5-pentachlorobiphenyl	2,2',3,4,5,5',6-heptachlorobiphenyl
2,3',4-trichlorobiphenyl	2,3,3',4',5-pentachlorobiphenyl	2,2',3,4',5,5',6-heptachlorobiphenyl
2,3,5-trichlorobiphenyl	2,3,3',4,6-pentachlorobiphenyl	2,3,3',4,4',5,5'-heptachlorobiphenyl
2',3,5-trichlorobiphenyl	2,3,3',4',6-pentachlorobiphenyl	2,3,3',4,4',5,6-heptachlorobiphenyl
2,3',5-trichlorobiphenyl	2,3,3',5,6-pentachlorobiphenyl	2,3,3',4,4',5',6-heptachlorobiphenyl
2,3',6-trichlorobiphenyl	2,3,4,4',5-pentachlorobiphenyl	2,3,3',4,5,5',6-heptachlorobiphenyl
2,4,4'-trichlorobiphenyl	2',3,4,4',5-pentachlorobiphenyl	2,3,3',4',5,5',6-heptachlorobiphenyl
2,4,5-trichlorobiphenyl	2,3',4,4',5-pentachlorobiphenyl	2,2',3,3',4,4',5,5'-octachlorobiphenyl
2,4',5-trichlorobiphenyl	2,3,4,4',6-pentachlorobiphenyl	2,2',3,3',4,4',5,6-octachlorobiphenyl
2,4',6-trichlorobiphenyl	2,3',4,4',6-pentachlorobiphenyl	2,2',3,3',4,4',5',6-octachlorobiphenyl
3,4,4'-trichlorobiphenyl	3,3',4,4',5-pentachlorobiphenyl	2,2',3,3',4,4',6,6'-octachlorobiphenyl
2,2',3,3'-tetrachlorobiphenyl	2,3,4,5,6-pentachlorobiphenyl	2,2',3,3',4,5,5',6'-octachlorobiphenyl
2,2',3,4'-tetrachlorobiphenyl	2,2',3,3',4,4'-hexachlorobiphenyl	2,2',3,3',4,5,5',6-octachlorobiphenyl
2,2',3,4-tetrachlorobiphenyl	2,2',3,3',4,5'-hexachlorobiphenyl	2,2',3,3',4,5,6,6'-octachlorobiphenyl
2,2',3,5'-tetrachlorobiphenyl	2,2',3,3',4,5-hexachlorobiphenyl	2,2',3,3',4,5',6,6'-octachlorobiphenyl
2,2',3,6'-tetrachlorobiphenyl	2,2',3,3',4,6'-hexachlorobiphenyl	2,2',3,3',5,5',6,6'-octachlorobiphenyl
2,2',3,6-tetrachlorobiphenyl	2,2',3,3',5,6'-hexachlorobiphenyl	2,2',3,4,4',5,5',6-octachlorobiphenyl
2,2',4,4'-tetrachlorobiphenyl	2,2',3,3',5,6-hexachlorobiphenyl	2,3,3',4,4',5,5',6-octachlorobiphenyl
2,2',4,5'-tetrachlorobiphenyl	2,2',3,3',6,6'-hexachlorobiphenyl	2,2',3,3',4,4',5,5',6-nonachlorobiphenyl
2,2',4,5-tetrachlorobiphenyl	2,2',3,4,4',5'-hexachlorobiphenyl	2,2',3,3',4,4',5,6,6'-nonachlorobiphenyl
2,2',5,5'-tetrachlorobiphenyl	2,2',3,4,4',5-hexachlorobiphenyl	2,2',3,3',4,5,5',6,6'-nonachlorobiphenyl
2,2',5,6'-tetrachlorobiphenyl	2,2',3,4,4',6'-hexachlorobiphenyl	decachlorobiphenyl
2,2',6,6'-tetrachlorobiphenyl	2,2',3,4,5,5'-hexachlorobiphenyl	Aroclor 1016
2,3,3',4'-tetrachlorobiphenyl	2,2',3,4',5,5'-hexachlorobiphenyl	Aroclor 1221
2,3,3',5'-tetrachlorobiphenyl	2,2',3,4,5',6-hexachlorobiphenyl	Aroclor 1232
2,3,4,4'-tetrachlorobiphenyl	2,2',3,4',5',6-hexachlorobiphenyl	Aroclor 1242
2,3',4,4'-tetrachlorobiphenyl	2,2',3,4,5,6'-hexachlorobiphenyl	Aroclor 1248
2,3',4,5-tetrachlorobiphenyl	2,2',3,5,5',6-hexachlorobiphenyl	Aroclor 1254
2,3',4',5-tetrachlorobiphenyl	2,2',4,4',5,5'-hexachlorobiphenyl	Aroclor 1260
2,3',4,6-tetrachlorobiphenyl	2,3,3',4,4',5'-hexachlorobiphenyl	Total PCB
2,3,4',6-tetrachlorobiphenyl	2,3,3',4,4',5-hexachlorobiphenyl	

Table 3-1: Constituents of Chemical Groups in PREmis Database

PESTICIDES
2,4'-DDD
2,4'-DDE
2,4'-DDT
4,4'-DDD
4,4'-DDE
4,4'-DDT
Aldrin
BHC, alpha
BHC, beta
BHC, delta
BHC, gamma
BHCs, total
CHLORDANE
Chlordane, alpha (cis)
Chlordane, gamma (trans)
Chlordane, oxy-
Chlordene - alpha (Historical)
Chlordene - gamma (Historical)
Dieldrin
Diphenyl disulfide (Historical)
Endosulfan sulfate
Endosulfan, alpha
Endosulfan, beta
Endrin
Endrin aldehyde
Endrin ketone
Heptachlor
Heptachlor epoxide
Heptachlor epoxide (endo) (Historical)
Heptachlor epoxide (exo) (Historical)
Isopropalin (Historical)
Kelthane (Historical)
Methoxychlor
Mirex
Nonachlor, cis-
Nonachlor, trans-
Octachlorostyrene (Historical)
Perthane (Historical)
Total DDT
Toxaphene

Table 3-1: Constituents of Chemical Groups in PREmis Database

HERBICIDES	DIOXINS/FURANS
2,4,5-T	1,2,3,4,6,7,8-HpCDD
2,4,5-TP	1,2,3,4,6,7,8-HpCDF
2,4-D	1,2,3,4,7,8,9-HpCDF
2,4-DB	1,2,3,4,7,8-HxCDD
Dalapon	1,2,3,4,7,8-HxCDF
Dicamba	1,2,3,6,7,8-HxCDD
Dichloroprop	1,2,3,6,7,8-HxCDF
DINOSEB	1,2,3,7,8,9-HxCDD
MCPA	1,2,3,7,8,9-HxCDF
MCPP	1,2,3,7,8-PeCDD
	1,2,3,7,8-PeCDF
	2,3,4,6,7,8-HxCDF
	2,3,4,6,7-PeCDF
	2,3,4,7,8-PeCDF
	2,3,6,7-TeCDF
	2,3,7,8-TCDD
	2,3,7,8-TCDF
	3,4,6,7-TeCDF
	Total HpCDD
	Total HpCDF
	Total HxCDD
	Total HxCDF
	Total PCDDs
	Total PCDFs
	Total PeCDD
	Total PeCDF
	Total TCDD
	Total TCDF
	Total OCDD
	Total OCDF

Table 3-1: Constituents of Chemical Groups in PREmis Database

SEMIVOLATILE ORGANICS	
1,2,3,4-Tetrachlorobenzene (Historical)	BIS(2-CHLOROETHYL)ETHER
1,4-Dichlorobenzene	BIS(2-CHLOROISOPROPYL)ETHER
Hexachlorobenzene	BIS(2-ETHYLHEXYL)PHTHALATE
1,2,4,5-TETRACHLOROBENZENE	BUTYL BENZYL PHTHALATE
1,2,4-TRICHLOROBENZENE	CARBAZOLE
2,4,5-TRICHLOROPHENOL	CHLOROBENZILATE
2,4,6-TRICHLOROPHENOL	Chlorpyrifos (Historical)
2,4-DICHLOROPHENOL	DACTHAL
2,4-DIMETHYLPHENOL	DIBENZOFURAN
2,4-DINITROPHENOL	DIBENZOTHIOPHENE
2,4-DINITROTOLUENE	DIBUTYLTIN
2,6-/2,7-DIMETHYLNAPHTHALENE	DIETHYL PHTHALATE
2,6-DINITROTOLUENE	DIMETHYLPHTHALATE
2-CHLORONAPHTHALENE	DI-N-BUTYL PHTHALATE
2-CHLOROPHENOL	DI-N-OCTYL PHTHALATE
2-NITROANILINE	HEXACHLOROBUTADIENE
2-NITROPHENOL	HEXACHLOROCYCLOPENTADIENE
3,3'-DICHLOROBENZIDINE	HEXACHLOROETHANE
3-METHYLPHENOL/4-METHYLPHENOL	ISOPHORONE
3-NITROANILINE	M-DICHLOROBENZENE
4,6-DINITRO-O-CRESOL	MONOBUTYLTIN
4-BROMOPHENYL PHENYL ETHER	NITROBENZENE
4-CHLORO-3-METHYLPHENOL	N-NITROSODIMETHYLAMINE
4-CHLOROANILINE	N-NITROSO-DI-PHENYLAMINE
4-CHLOROPHENYL PHENYL ETHER	N-NITROSO-DI-PROPYLAMINE
4-METHYLPHENOL	O-CRESOL
4-NITROANILINE	O-DICHLOROBENZENE
4-NITROPHENOL	PENTACHLOROANISOLE
ANILINE	PENTACHLOROBENZENE
Azobenzene (Historical)	PENTACHLORONITROBENZENE
Benzidine (Historical)	PHENOL
BENZO(b)THIOPHENE	PYRIDINE
BENZOIC ACID	TETRABUTYLTIN
BENZYL ALCOHOL	TRIBUTYLTIN
BIS(2-CHLOROETHOXY)METHANE	Trifluralin (Historical)

Table 3-1: Constituents of Chemical Groups in PREmis Database

VOLATILE ORGANICS	
1,1,1,2-TETRACHLOROETHANE	CIS-1,2-DICHLOROETHYLENE
1,1,1-TRICHLOROETHANE	CIS-1,3-DICHLOROPROPENE
1,1,2,2-TETRACHLOROETHANE	cis-1,4-Dichloro-2-butene (Historical)
1,1,2-TRICHLOROETHANE	DICHLOROBROMOMETHANE
1,1-DICHLOROETHANE	DICHLORODIFLUOROMETHANE
1,1-DICHLOROETHENE	ETHYL METHACRYLATE
1,1-DICHLOROPROPENE	ETHYLBENZENE
1,2,3-Trichlorobenzene (Historical)	Freon TF (Historical)
1,2,3-TRICHLOROPROPANE	ISOBUTYL ALCOHOL
1,2,4-Trimethylbenzene (Historical)	Isopropylbenzene (Historical)
1,2-DIBROMO-3-CHLOROPROPANE	m&p-Xylene (Historical)
1,2-DIBROMOETHANE	METHACRYLONITRILE
1,2-DICHLOROETHANE	METHYL BROMIDE
1,2-DICHLOROETHYLENE (Historical)	METHYL CHLORIDE
1,2-DICHLOROPROPANE	METHYL ETHYL KETONE
1,3,5-Trimethylbenzene (Historical)	METHYL IODIDE
1,3-DICHLOROPROPANE	METHYL METHACRYLATE
1,4-DIOXANE	METHYLENE BROMIDE
2,2-DICHLOROPROPANE	METHYLENE CHLORIDE
2-Chloroethylvinylether (Historical)	Methyl-t-Butyl Ether
2-Chlorotoluene (Historical)	n-Butylbenzene (Historical)
2-HEXANONE (Historical)	n-Propylbenzene (Historical)
4-Chlorotoluene (Historical)	O-XYLENE (Historical)
4-METHYL-2-PENTANONE (Historical)	p-Isopropyltoluene (Historical)
ACETONE	PROPIONITRILE
Acid Volatile sulfides (Historical)	sec-Butylbenzene (Historical)
ACROLEIN	STYRENE
ACRYLONITRILE	tert-Butylbenzene (Historical)
ALLYL CHLORIDE	TETRACHLOROETHYLENE
BENZENE	Tetrahydrofuran (Historical)
Bromobenzene (Historical)	TOLUENE
BROMOCHLOROMETHANE	Total BTEX (Historical)
BROMOFORM	Total Xylenes (Historical)
CARBON DISULFIDE	TRANS-1,2-DICHLOROETHYLENE
CARBON TETRACHLORIDE	TRANS-1,3-DICHLOROPROPENE
CHLOROBENZENE	TRANS-1,4-DICHLORO-2-BUTENE
CHLORODIBROMOMETHANE	TRICHLOROETHYLENE
CHLOROETHANE	TRICHLOROFLUOROMETHANE
CHLOROFORM	VINYL ACETATE
CHLOROPRENE	VINYL CHLORIDE

Table 3-1: Constituents of Chemical Groups in PREmis Database

RADIONUCLIDES	PETROLEUM
Be-7	Total Petroleum
Cs-137	
Pb-210	
Po-210	

Table 4-8: VOCs Listed in PREmis Database

BTEX VOCs	
CAS Number	Chemical
71-43-2	BENZENE
100-41-4	ETHYLBENZENE
108-88-3	TOLUENE
BTEX	Total BTEX (Historical)
TXYLENES	Total Xylenes (Historical)

CHLORINATED VOCs	
CAS Number	Chemical
71-55-6	1,1,1-TRICHLOROETHANE
75-34-3	1,1-DICHLOROETHANE
540-59-0	1,2-DICHLOROETHYLENE (Historical)
78-87-5	1,2-DICHLOROPROPANE
67-66-3	CHLOROFORM
10061-01-5	CIS-1,3-DICHLOROPROPENE
75-09-2	METHYLENE CHLORIDE
127-18-4	TETRACHLOROETHYLENE
79-34-5	1,1,2,2-TETRACHLOROETHANE
79-00-5	1,1,2-TRICHLOROETHANE
75-35-4	1,1-DICHLOROETHENE
107-06-2	1,2-DICHLOROETHANE
56-23-5	CARBON TETRACHLORIDE
108-90-7	CHLOROBENZENE
124-48-1	CHLORODIBROMOMETHANE
75-00-3	CHLOROETHANE
75-27-4	DICHLOROBROMOMETHANE
74-83-9	METHYL BROMIDE
74-87-3	METHYL CHLORIDE
10061-02-6	TRANS-1,3-DICHLOROPROPENE
79-01-6	TRICHLOROETHYLENE
75-01-4	VINYL CHLORIDE

OTHER VOCs	
CAS Number	Chemical
591-78-6	2-HEXANONE (Historical)
108-10-1	4-METHYL-2-PENTANONE (Historical)
67-64-1	ACETONE
AVS	Acid Volatile sulfides (Historical)
75-25-2	BROMOFORM
75-15-0	CARBON DISULFIDE
78-93-3	METHYL ETHYL KETONE
100-42-5	STYRENE
108-05-4	VINYL ACETATE

Table 4-9: Statistical Report for Surface Sediment Samples, BTEX VOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Volatile														
Subclass: BTEX														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
71-43-2	BENZENE	2.00E+00	M	3.00E+02	M	NG/G	8.30E+01	Harrison Reach	5 / 142	4%	5.70E+01	OSWER	2 / 142	1%
100-41-4	ETHYLBENZENE	2.00E+00	JL	2.40E+02	JL	NG/G	5.20E+01	Newark Reach	9 / 142	6%	8.90E+01	NAWQC	1 / 142	1%
108-88-3	TOLUENE	2.00E+00	DJL	2.80E+03	DJL	NG/G	3.16E+02	Kearny Reach	10 / 142	7%	5.00E+01	NAWQC	5 / 142	4%
BTEX	Total BTEX (Historical)	2.00E+00		2.80E+03		NG/G	2.87E+02	Kearny Reach	19 / 142	13%	--	--	-- / 142	--
TXYLENES	Total Xylenes (Historical)	2.00E+00		4.40E+02		NG/G	1.08E+02	Point No Point Reach	13 / 142	9%	2.50E+01	OSWER	9 / 142	6%

Screening criteria:

NAWQC: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Secondary Chronic Values.

OSWER: EPA Office of Solid Waste and Emergency Response Ecotox Thresholds (ET). Jones *et al.* , 1997.



Table 4-10: Statistical Report for Subsurface Sediment Samples, BTEX VOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Volatile														
Subclass: BTEX														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
71-43-2	BENZENE	4.00E+00		3.30E+03		NG/G	1.44E+02	Newark Reach	97 / 537	18%	5.70E+01	OSWER	25 / 537	5%
100-41-4	ETHYLBENZENE	4.00E+00		3.10E+04		NG/G	7.18E+02	Newark Reach	77 / 537	14%	8.90E+01	NAWQC	33 / 537	6%
M&PXYLENE	m&p-Xylene (Historical)	3.00E+00		1.40E+03		NG/G	2.40E+02	Newark Reach	9 / 11	82%	--		-- / 11	0%
95-47-6	O-XYLENE (Historical)	9.00E+00		1.00E+04		NG/G	1.56E+03	Newark Reach	8 / 11	73%	--		-- / 11	0%
108-88-3	TOLUENE	5.00E+00		8.70E+02		NG/G	1.24E+02	Point No Point Reach	83 / 537	15%	5.00E+01	NAWQC	45 / 537	8%
BTEX	Total BTEX (Historical)	3.00E+00		1.52E+05		NG/G	1.40E+03	Upstream Reach	255 / 537	47%	--		-- / 537	0%
TXYLENES	Total Xylenes (Historical)	3.00E+00		1.50E+05		NG/G	1.13E+03	Upstream Reach	233 / 526	44%	2.50E+01	OSWER	216 / 526	41%

Screening criteria:

NAWQC: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Secondary Chronic

OSWER: EPA Office of Solid Waste and Emergency Response Ecotox Thresholds (ET). Jones *et al.* , 1997

Table 4-11: Statistical Report for Surface Sediment Samples, Chlorinated VOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern													
CLASS: Volatile													
Subclass: Chlorinated VOC													
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency
71-55-6	1,1,1-TRICHLOROETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
75-34-3	1,1-DICHLOROETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
540-59-0	1,2-DICHLOROETHYLENE (Historical)	7.00E+00		2.00E+01		NG/G	1.40E+01	Upstream Reach	3 / 142	2%	--		-- / 142 0%
78-87-5	1,2-DICHLOROPROPANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
67-66-3	CHLOROFORM	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
10061-01-5	CIS-1,3-DICHLOROPROPENE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
75-09-2	METHYLENE CHLORIDE	2.00E+00		3.70E+01		NG/G	1.40E+01	Point No Point Reach	7 / 142	5%	1.59E+02	USEPA Region 5	-- / 142 0%
127-18-4	TETRACHLOROETHYLENE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
79-34-5	1,1,2,2-TETRACHLOROETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
79-00-5	1,1,2-TRICHLOROETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
75-35-4	1,1-DICHLOROETHENE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
107-06-2	1,2-DICHLOROETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
56-23-5	CARBON TETRACHLORIDE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
108-90-7	CHLOROBENZENE	5.00E+00		1.40E+03		NG/G	2.26E+02	Upstream Reach	16 / 142	11%	2.91E+02	USEPA Region 5	2 / 142 1%
124-48-1	CHLORODIBROMOMETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
75-00-3	CHLOROETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
75-27-4	DICHLOROBROMOMETHANE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
74-83-9	METHYL BROMIDE	1.20E+01	J	1.20E+01	J	NG/G	1.20E+01	Newark Reach	1 / 142	1%	--		-- / 142 0%
74-87-3	METHYL CHLORIDE	3.00E+00		4.80E+01		NG/G	1.70E+01	Upstream Reach	6 / 142	4%	--		-- / 142 0%
10061-02-6	TRANS-1,3-DICHLOROPROPENE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
79-01-6	TRICHLOROETHYLENE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%
75-01-4	VINYL CHLORIDE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142 0%

Screening criteria used: USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-12: Statistical Report for Subsurface Sediment Samples, Chlorinated VOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Volatile														
Subclass: Chlorinated VOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
630-20-6	1,1,1,2-TETRACHLOROETHANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
71-55-6	1,1,1-TRICHLOROETHANE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
75-34-3	1,1-DICHLOROETHANE	3.70E+01	JH	3.90E+02	JH	NG/G	2.14E+02	Harrison Reach	2 / 537	0.4%	--		-- / 537	0%
87-61-6	1,2,3-Trichlorobenzene (Historical)	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
540-59-0	1,2-DICHLOROETHYLENE (Historical)	--	--	--	--	--	--	--	-- / 526	0%	--		-- / 526	0%
78-87-5	1,2-DICHLOROPROPANE	8.30E+01	M	8.30E+01	M	NG/G	8.30E+01	Harrison Reach	1 / 537	0.2%	--		-- / 537	0%
142-28-9	1,3-DICHLOROPROPANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
74-97-5	BROMOCHLOROMETHANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
67-66-3	CHLOROFORM	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
156-59-2	CIS-1,2-DICHLOROETHYLENE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
10061-01-5	CIS-1,3-DICHLOROPROPENE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
75-09-2	METHYLENE CHLORIDE	3.00E+00	DM	5.80E+04	DM	NG/G	2.09E+03	Harrison Reach	31 / 537	6%	1.59E+02	USEPA Region 5	4 / 537	0.7%
127-18-4	TETRACHLOROETHYLENE	9.50E+01	JH	2.40E+02	JH	NG/G	1.62E+02	Harrison Reach	4 / 537	1%	4.10E+02	NAWQC	-- / 537	0%
156-60-5	TRANS-1,2-DICHLOROETHYLENE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
79-34-5	1,1,2,2-TETRACHLOROETHANE	2.90E+01	J	2.90E+01	J	NG/G	2.90E+01	Newark Reach	1 / 537	0.2%	--		-- / 537	0%
79-00-5	1,1,2-TRICHLOROETHANE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
75-35-4	1,1-DICHLOROETHENE	2.80E+01	M	2.80E+01	M	NG/G	2.80E+01	Kearny Reach	1 / 537	0.2%	--		-- / 537	0%
563-58-6	1,1-DICHLOROPROPENE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
96-18-4	1,2,3-TRICHLOROPROPANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
107-06-2	1,2-DICHLOROETHANE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
594-20-7	2,2-DICHLOROPROPANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
95-49-8	2-Chlorotoluene (Historical)	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
106-43-4	4-Chlorotoluene (Historical)	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
56-23-5	CARBON TETRACHLORIDE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
108-90-7	CHLOROBENZENE	3.00E+00	DJ	2.90E+05	DJ	NG/G	1.56E+04	Harrison Reach	47 / 537	9%	2.91E+02	USEPA Region 5	11 / 537	2%
124-48-1	CHLORODIBROMOMETHANE	--	--	--	--	--	--	--	0 / 537	0%	--		-- / 537	0%
75-00-3	CHLOROETHANE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
75-27-4	DICHLOROBROMOMETHANE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
74-83-9	METHYL BROMIDE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
74-87-3	METHYL CHLORIDE	7.00E+00		7.00E+00		NG/G	7.00E+00	Point No Point Reach	1 / 537	0.2%	--		-- / 537	0%
10061-02-6	TRANS-1,3-DICHLOROPROPENE	--	--	--	--	--	--	--	-- / 537	0%	--		-- / 537	0%
79-01-6	TRICHLOROETHYLENE	5.10E+01	JH	5.10E+01	JH	NG/G	5.10E+01	Harrison Reach	1 / 537	0.2%	1.12E+02	USEPA Region 5	-- / 537	0%
75-69-4	TRICHLOROFLUOROMETHANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
75-01-4	VINYL CHLORIDE	1.30E+01		4.90E+01		NG/G	3.10E+01	Kearny Reach	2 / 537	0.4%	--		-- / 537	0%

Screening criteria used:

NAWQC: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Secondary Chronic

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-13: Statistical Report for Surface Sediment Samples, Other VOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Volatile														
Subclass: Other VOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
591-78-6	2-HEXANONE (Historical)	--	--	--	--	--	--	--	-- / 142	0%	2.20E+01	NAWQC	-- / 142	0%
108-10-1	4-METHYL-2-PENTANONE (Historical)	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142	0%
67-64-1	ACETONE	8.00E+00		1.40E+04		NG/G	4.69E+02	Harrison Reach	97 / 142	68%	9.00E+00	NAWQC	96 / 142	68%
AVS	Acid Volatile sulfides (Historical)	9.80E-01		9.40E+01		UMOLES/G	3.20E+01	Point No Point Reach	11 / 11	100%	--		-- / 11	0%
75-25-2	BROMOFORM	--	--	--	--	--	--	--	-- / 142	0%	4.92E+02	USEPA Region 5	-- / 142	0%
75-15-0	CARBON DISULFIDE	2.00E+00		5.00E+00		NG/G	4.00E+00	Newark Reach	3 / 142	2%	8.50E-01	NAWQC	3 / 142	2%
78-93-3	METHYL ETHYL KETONE	9.00E+00	JL	8.30E+01	JL	NG/G	3.60E+01	Point No Point Reach	29 / 142	20%	4.30E+01	USEPA Region 5	9 / 142	6%
100-42-5	STYRENE	--	--	--	--	--	--	--	-- / 142	0%	--		-- / 142	0%
108-05-4	VINYL ACETATE	--	--	--	--	--	--	--	-- / 4	0%	--		-- / 4	0%

Screening criteria used:

NAWQC: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Secondary Chronic Values.

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-14: Statistical Report for Subsurface Sediment Samples, Other VOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Volatile														
Subclass: Other VOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
95-63-6	1,2,4-Trimethylbenzene (Historical)	6.00E+00		2.60E+04		NG/G	3.12E+03	Newark Reach	10 / 11	91%	--		-- / 11	0%
106-93-4	1,2-DIBROMOETHANE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
108-67-8	1,3,5-Trimethylbenzene (Historical)	5.00E+00		1.20E+04		NG/G	1.37E+03	Newark Reach	10 / 11	91%	--		-- / 11	0%
591-78-6	2-HEXANONE (Historical)	3.80E+01		3.80E+01		NG/G	3.80E+01	Point No Point Reach	1 / 526	0.2%	2.20E+01	NAWQC	1 / 526	0.2%
108-10-1	4-METHYL-2-PENTANONE (Historical)	--	--	--	--	--	--	--	-- / 526	0%	--		-- / 526	0%
67-64-1	ACETONE	1.20E+01		5.00E+04		NG/G	8.75E+02	Upstream Reach	397 / 526	75%	9.00E+00	NAWQC	397 / 526	75%
108-86-1	Bromobenzene (Historical)	6.00E+00		6.00E+00		NG/G	6.00E+00	Harrison Reach	1 / 11	9%	--		-- / 11	0%
75-25-2	BROMOFORM		--		--	--		--	0 / 537	0%	--		-- / 537	0%
75-15-0	CARBON DISULFIDE	2.00E+00	JH	4.60E+01	JH	NG/G	1.80E+01	Point No Point Reach	19 / 526	4%	8.50E-01	NAWQC	19 / 526	4%
75-71-8	DICHLORODIFLUOROMETHAN E	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
98-82-8	Isopropylbenzene (Historical)	6.00E+00		6.70E+03		NG/G	9.92E+02	Newark Reach	8 / 11	73%	--		-- / 11	0%
78-93-3	METHYL ETHYL KETONE	1.00E+01		7.20E+03		NG/G	1.09E+02	Harrison Reach	315 / 526	60%	4.30E+01	USEPA Region 5	196 / 526	37%
74-95-3	METHYLENE BROMIDE	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
104-51-8	n-Butylbenzene (Historical)	5.00E+00		9.00E+00		NG/G	7.00E+00	Newark Reach	2 / 11	18%	--		-- / 11	0%
103-65-1	n-Propylbenzene (Historical)	8.00E+00		2.30E+03		NG/G	3.82E+02	Newark Reach	7 / 11	64%	--		-- / 11	0%
99-87-6	p-Isopropyltoluene (Historical)	4.00E+00		8.20E+03		NG/G	1.22E+03	Newark Reach	8 / 11	73%	--		-- / 11	0%
135-98-8	sec-Butylbenzene (Historical)	5.00E+00		2.00E+02		NG/G	3.80E+01	Newark Reach	7 / 11	64%	--		-- / 11	0%
100-42-5	STYRENE	1.10E+02	JL	1.10E+02	JL	NG/G	1.10E+02	Harrison Reach	1 / 537	0.2%	--		-- / 537	0%
98-06-6	tert-Butylbenzene (Historical)	--	--	--	--	--	--	--	-- / 11	0%	--		-- / 11	0%
108-05-4	VINYL ACETATE	--	--	--	--	--	--	--	-- / 6	0%	--		-- / 6	0%

Screening criteria used:

NAWQC: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Secondary Chronic

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-15: SVOCs (non-PAH) Listed in PREmis Database

PHENOLIC SVOCs	
CAS Number	Chemical
95-95-4	2,4,5-TRICHLOROPHENOL
120-83-2	2,4-DICHLOROPHENOL
95-57-8	2-CHLOROPHENOL
88-75-5	2-NITROPHENOL
100-02-7	4-NITROPHENOL
108-95-2	PHENOL
87-86-5	2,3,4,5,6-PENTACHLOROPHENOL
88-06-2	2,4,6-TRICHLOROPHENOL
105-67-9	2,4-DIMETHYLPHENOL
51-28-5	2,4-DINITROPHENOL
534-52-1	4,6-DINITRO-O-CRESOL
59-50-7	4-CHLORO-3-METHYLPHENOL
106-44-5	4-METHYLPHENOL

PHTHALATE SVOCs	
CAS Number	Chemical
85-68-7	BUTYL BENZYL PHTHALATE
117-84-0	DI-N-OCTYL PHTHALATE
84-66-2	DIETHYL PHTHALATE
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE
84-74-2	DI-N-BUTYL PHTHALATE
131-11-3	DIMETHYLPHTHALATE

OTHER SVOCs	
CAS Number	Chemical
120-82-1	1,2,4-TRICHLOROBENZENE
88-74-4	2-NITROANILINE
65-85-0	BENZOIC ACID
100-51-6	BENZYL ALCOHOL
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER
132-65-0	DIBENZOTHIOPHENE
1002-53-5	DIBUTYLTIN
77-47-4	HEXACHLOROCYCLOPENTADIENE
67-72-1	HEXACHLOROETHANE
86-30-6	N-NITROSO-DI-PHENYLAMINE
98-95-3	NITROBENZENE
1825-21-4	PENTACHLOROANISOLE
56573-85-4	TRIBUTYLTIN
121-14-2	2,4-DINITROTOLUENE
606-20-2	2,6-DINITROTOLUENE
91-58-7	2-CHLORONAPHTHALENE
91-94-1	3,3'-DICHLOROBENZIDINE
99-09-2	3-NITROANILINE
101-55-3	4-BROMOPHENYL PHENYL ETHER
106-47-8	4-CHLOROANILINE
7005-72-3	4-CHLOROPHENYL PHENYL ETHER
100-01-6	4-NITROANILINE
95-15-8	BENZO(b)THIOPHENE
111-91-1	BIS(2-CHLOROETHOXY)METHANE
111-44-4	BIS(2-CHLOROETHYL)ETHER
86-74-8	CARBAZOLE
1861-32-1	DACTHAL
87-68-3	HEXACHLOROBUTADIENE
78-59-1	ISOPHORONE
541-73-1	M-DICHLOROBENZENE
78763-54-9	MONOBUTYLTIN
621-64-7	N-NITROSO-DI-PROPYLAMINE
95-50-1	O-DICHLOROBENZENE
1461-25-2	TETRABUTYLTIN

Table 4-16: Statistical Report for Surface Sediment Samples, Phenolic SVOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Semi-Volatile														
Subclass: phenolics SVOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
95-95-4	2,4,5-TRICHLOROPHENOL	3.00E+02		4.60E+03		NG/G	1.91E+03	Harrison Reach	5 / 242	2.1%	--		-- / 242	0%
120-83-2	2,4-DICHLOROPHENOL	3.50E+02		1.20E+04		NG/G	3.62E+03	Harrison Reach	9 / 242	3.7%	--		-- / 242	0%
95-57-8	2-CHLOROPHENOL	2.00E+02	GM	2.00E+02	GM	NG/G	2.00E+02	Harrison Reach	1 / 242	0.4%	3.20E+01	USEPA Region 5	1 / 242	0.4%
88-75-5	2-NITROPHENOL		--		--	--		--	0 / 242	0%	--		-- / 242	0%
100-02-7	4-NITROPHENOL	5.30E+02		5.30E+02		NG/G	5.30E+02	Upstream Reach	1 / 242	0.4%	1.40E+01	USEPA Region 5	1 / 242	0.4%
108-95-2	PHENOL	2.80E+02	M	3.10E+03	M	NG/G	1.34E+03	Harrison Reach	6 / 242	2.5%	3.10E+01	NAWQC Chronic	6 / 242	2%
87-86-5	2,3,4,5,6-PENTACHLOROPHENOL		--		--	--		--	0 / 242	0%	--		-- / 242	0%
88-06-2	2,4,6-TRICHLOROPHENOL	1.00E+03		1.00E+03		NG/G	1.00E+03	Harrison Reach	1 / 242	0.4%	--		-- / 242	0%
105-67-9	2,4-DIMETHYLPHENOL		--		--	--		--	0 / 242	0%	--		-- / 242	0%
51-28-5	2,4-DINITROPHENOL		--		--	--		--	0 / 242	0%	--		-- / 242	0%
534-52-1	4,6-DINITRO-O-CRESOL		--		--	--		--	0 / 242	0%	--		-- / 242	0%
59-50-7	4-CHLORO-3-METHYLPHENOL		--		--	--		--	0 / 242	0%	--		-- / 242	0%
106-44-5	4-METHYLPHENOL	1.30E+02		7.50E+03		NG/G	2.10E+03	Upstream Reach	9 / 242	3.7%	--		-- / 242	0%

Screening criteria used:

NAWQC Chronic: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Chronic Values.

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-17: Statistical Report for Subsurface Sediment Samples, Phenolic SVOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Semi-Volatile														
Subclass: phenolics SVOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
87-86-5	2,3,4,5,6-PENTACHLOROPHENOL	1.30E+04	M	1.30E+04	M	NG/G	1.30E+04	Point No Point Reach	1 / 611	0.2%	2.30E+04	USEPA Region 5	-- / 611	0%
88-06-2	2,4,6-TRICHLOROPHENOL	8.60E+02	DM	3.40E+05	DM	NG/G	6.14E+04	Harrison Reach	7 / 611	1%	--		-- / 611	0%
105-67-9	2,4-DIMETHYLPHENOL	2.10E+03		8.30E+04		NG/G	3.97E+04	Harrison Reach	3 / 611	0.5%	3.04E+02	USEPA Region 5	3 / 611	0.5%
51-28-5	2,4-DINITROPHENOL	6.30E+04		6.30E+04		NG/G	6.30E+04	Newark Reach	1 / 611	0.2%	--		-- / 611	0%
534-52-1	4,6-DINITRO-O-CRESOL	2.00E+03	J	2.20E+03	J	NG/G	2.10E+03	Harrison Reach	2 / 611	0.3%	--		-- / 611	0%
59-50-7	4-CHLORO-3-METHYLPHENOL	--	--	--	--	--	--	--	-- / 611	0%	--		-- / 611	0%
106-44-5	4-METHYLPHENOL	8.90E+02		6.30E+03		NG/G	2.80E+03	Harrison Reach	3 / 611	0.5%	--		-- / 611	0%
95-95-4	2,4,5-TRICHLOROPHENOL	1.30E+03	DM	8.30E+05	DM	NG/G	3.15E+05	Harrison Reach	6 / 611	1%	--		-- / 611	0%
120-83-2	2,4-DICHLOROPHENOL	7.60E+02	DM	2.50E+06	DM	NG/G	1.15E+05	Harrison Reach	31 / 611	5%	--		-- / 611	0%
95-57-8	2-CHLOROPHENOL	8.00E+03		4.00E+04		NG/G	2.40E+04	Harrison Reach	2 / 610	0.3%	3.20E+01	USEPA Region 5	2 / 610	0.3%
88-75-5	2-NITROPHENOL	--	--	--	--	--	--	--	-- / 611	0%	--		-- / 611	0%
100-02-7	4-NITROPHENOL		--		--	--		--	0 / 611	0%	--		-- / 611	0%
108-95-2	PHENOL	2.00E+03	M	2.30E+03	M	NG/G	2.15E+03	Harrison Reach	2 / 610	0.3%	3.10E+01	NAWQC Chronic	2 / 610	0.3%

Screening criteria used:

NAWQC Chronic: 1997 Sediment Quality Benchmarks, Marine/Estuarine - NAWQC Chronic Values.

USEPA Region 5, RCRA Ecological Screening Levels.



Table 4-18: Statistical Report for Surface Sediment Samples, Phthalate SVOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Semi-Volatile														
Subclass: phthalates SVOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
85-68-7	BUTYL BENZYL PHTHALATE	8.90E+01	J	3.60E+05	J	NG/G	7.00E+03	Kearny Reach	90 / 242	37%	1.97E+03	USEPA Region 5	6 / 242	2%
117-84-0	DI-N-OCTYL PHTHALATE	9.90E+01	M	9.00E+03	M	NG/G	1.07E+03	Kearny Reach	103 / 242	43%	4.06E+04	USEPA Region 5	-- / 242	0%
84-66-2	DIETHYL PHTHALATE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	5.60E+02	DM	2.30E+07	DM	NG/G	1.16E+05	Newark Reach	231 / 241	96%	1.82E+02	USEPA Region 5	231 / 241	95.9%
84-74-2	DI-N-BUTYL PHTHALATE	1.60E+02		1.90E+03		NG/G	5.07E+02	Newark Reach	25 / 242	10%	1.11E+03	USEPA Region 5	2 / 242	0%
131-11-3	DIMETHYLPHthalate	3.90E+02		2.00E+03		NG/G	1.03E+03	Upstream Reach	4 / 244	2%	--		-- / 244	0%
1861-32-1	DACTHAL	2.00E+00		3.00E+00		NG/G	2.00E+00	Harrison Reach	11 / 11	100%	--		-- / 11	0%

Screening criteria used:

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-19: Statistical Report for Subsurface Sediment Samples, Phthalate SVOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Semi-Volatile														
Subclass: phthalates SVOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
85-68-7	BUTYL BENZYL PHTHALATE	4.20E+02	J	2.50E+04	J	NG/G	2.84E+03	Kearny Reach	41 / 611	7%	1.97E+03	USEPA Region 5	10 / 611	2%
117-84-0	DI-N-OCTYL PHTHALATE	2.20E+02		1.70E+05		NG/G	5.54E+03	Point No Point Reach	265 / 611	43%	4.06E+04	USEPA Region 5	2 / 611	0%
84-66-2	DIETHYL PHTHALATE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	2.60E+02		1.70E+06		NG/G	4.19E+04	Harrison Reach	410 / 611	67%	1.82E+02	USEPA Region 5	410 / 611	67%
84-74-2	DI-N-BUTYL PHTHALATE	3.80E+02		3.80E+04		NG/G	3.86E+03	Point No Point Reach	30 / 611	5%	1.11E+03	USEPA Region 5	24 / 611	4%
131-11-3	DIMETHYLPHTHALATE		--		--	--		--	0 / 611	0%	--		-- / 611	0%

Screening criteria used:

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-20: Statistical Report for Surface Sediment Samples, Other SVOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Semi-Volatile														
Subclass: other SVOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
120-82-1	1,2,4-TRICHLOROBENZENE	6.40E+01		2.50E+03		NG/G	3.78E+02	Point No Point Reach	10 / 242	4%	5.06E+03	USEPA Region 5	-- / 242	0%
88-74-4	2-NITROANILINE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
65-85-0	BENZOIC ACID	--	--	--	--	--	--	--	-- / 6	0%	--		-- / 6	0%
100-51-6	BENZYL ALCOHOL	--	--	--	--	--	--	--	-- / 6	0%	--		-- / 6	0%
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER		--		--	--		--	0 / 242	0%	--		-- / 242	0%
132-65-0	DIBENZOTHIOPHENE	4.30E+01		1.90E+03		NG/G	2.27E+02	Upstream Reach	82 / 84	98%	--		-- / 84	0%
1002-53-5	DIBUTYLTIN	2.00E+00		7.42E+02		NG/G	5.00E+01	Point No Point Reach	80 / 95	84%	--		-- / 95	0%
77-47-4	HEXACHLOROCYCLOPENTADIENE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
67-72-1	HEXACHLOROETHANE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
86-30-6	N-NITROSO-DI-PHENYLAMINE	6.50E+01	M	2.10E+03	M	NG/G	2.41E+02	Newark Reach	16 / 242	7%	--		-- / 242	0%
98-95-3	NITROBENZENE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
1825-21-4	PENTACHLOROANISOLE	4.00E-01		8.00E-01		NG/G	6.89E-01	Harrison Reach	9 / 9	100%	--		-- / 9	0%
56573-85-4	TRIBUTYLTIN	6.00E+00	IM	6.90E+02	IM	NG/G	5.20E+01	Kearny Reach	72 / 95	76%	--		-- / 95	0%
121-14-2	2,4-DINITROTOLUENE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
606-20-2	2,6-DINITROTOLUENE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
91-58-7	2-CHLORONAPHTHALENE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
91-94-1	3,3'-DICHLOROBENZIDINE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
99-09-2	3-NITROANILINE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
101-55-3	4-BROMOPHENYL PHENYL ETHER		--		--	--		--	0 / 242	0%	--		-- / 242	0%
106-47-8	4-CHLOROANILINE	7.70E+02	M	7.70E+02	M	NG/G	7.70E+02	Harrison Reach	1 / 242	0.4%	--		-- / 242	0%
7005-72-3	4-CHLOROPHENYL PHENYL ETHER		--		--	--		--	0 / 242	0%	--		-- / 242	0%
100-01-6	4-NITROANILINE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
95-15-8	BENZO(b)THIOPHENE	8.00E+00	j	1.30E+02	j	NG/G	3.30E+01	Point No Point Reach	7 / 11	64%	--		-- / 11	0%
111-91-1	BIS(2-CHLOROETHOXY)METHANE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
111-44-4	BIS(2-CHLOROETHYL)ETHER		--		--	--		--	0 / 242	0%	--		-- / 242	0%
86-74-8	CARBAZOLE	1.20E+02		1.10E+04		NG/G	7.49E+02	Newark Reach	66 / 236	28%	--		-- / 236	0%
87-68-3	HEXACHLOROBUTADIENE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
78-59-1	ISOPHORONE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
541-73-1	M-DICHLOROBENZENE	7.00E+01	G	7.00E+01	G	NG/G	7.00E+01	Harrison Reach	1 / 242	0.4%	1.32E+03	USEPA Region 5	-- / 242	0%
78763-54-9	MONOBUTYLTIN	2.33E-01		8.35E+02		NG/G	3.80E+01	Point No Point Reach	47 / 95	49%	--		-- / 95	0%
621-64-7	N-NITROSO-DI-PROPYLAMINE		--		--	--		--	0 / 242	0%	--		-- / 242	0%
95-50-1	O-DICHLOROBENZENE	1.60E+02	GM	4.10E+02	GM	NG/G	2.85E+02	Harrison Reach	2 / 242	1%	2.94E+02	USEPA Region 5	1 / 242	0.4%
1461-25-2	TETRABUTYLTIN	5.08E-01		3.70E+01		NG/G	4.00E+00	Point No Point Reach	13 / 76	17%	--		-- / 76	0%

Screening criteria used:

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-21: Statistical Report for Subsurface Sediment Samples, Other SVOCs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Semi-Volatile														
Subclass: other SVOC														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
120-82-1	1,2,4-TRICHLOROBENZENE	1.80E+03	DM	1.10E+06	DM	NG/G	1.72E+05	Harrison Reach	9 / 622	1%	5.06E+03	USEPA Region 5	6 / 622	1%
88-74-4	2-NITROANILINE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER		--		--	--		--	0 / 611	0%	--		-- / 611	0%
1002-53-5	DIBUTYL TIN	2.79E+02		3.18E+03		NG/G	1.36E+03	Point No Point Reach	6 / 45	13%	--		-- / 45	0%
77-47-4	HEXACHLOROCYCLOPENTADIENE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
67-72-1	HEXACHLOROETHANE	6.90E+02	M	6.90E+02	M	NG/G	6.90E+02	Newark Reach	1 / 611	0.2%	--		-- / 611	0%
86-30-6	N-NITROSO-DI-PHENYLAMINE	3.60E+02		3.60E+03		NG/G	1.63E+03	Harrison Reach	9 / 611	1%	--		-- / 611	0%
98-95-3	NITROBENZENE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
56573-85-4	TRIBUTYL TIN	2.98E+02		5.84E+02		NG/G	4.12E+02	Point No Point Reach	3 / 45	7%	--		-- / 45	0%
121-14-2	2,4-DINITROTOLUENE	7.10E+02		1.00E+04		NG/G	3.05E+03	Newark Reach	4 / 611	1%	--		-- / 611	0%
606-20-2	2,6-DINITROTOLUENE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
91-58-7	2-CHLORONAPHTHALENE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
91-94-1	3,3'-DICHLOBENZIDINE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
99-09-2	3-NITROANILINE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
101-55-3	4-BROMOPHENYL PHENYL ETHER		--		--	--		--	0 / 611	0%	--		-- / 611	0%
106-47-8	4-CHLOROANILINE	5.80E+02		1.80E+03		NG/G	1.15E+03	Point No Point Reach	4 / 611	1%	--		-- / 611	0%
7005-72-3	4-CHLOROPHENYL PHENYL ETHER		--		--	--		--	0 / 611	0%	--		-- / 611	0%
100-01-6	4-NITROANILINE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
111-91-1	BIS(2-CHLOROETHOXY)METHANE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
111-44-4	BIS(2-CHLOROETHYL)ETHER		--		--	--		--	0 / 611	0%	--		-- / 611	0%
86-74-8	CARBAZOLE	2.80E+02		2.60E+04		NG/G	2.64E+03	Harrison Reach	50 / 611	8%	--		-- / 611	0%
87-68-3	HEXACHLOROBUTADIENE	8.00E+00	M	6.70E+02	M	NG/G	3.39E+02	Harrison Reach	2 / 622	0.3%	2.70E+01	USEPA Region 5	1 / 622	0.2%
78-59-1	ISOPHORONE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
541-73-1	M-DICHLOROBENZENE	4.00E+00		2.10E+04		NG/G	4.67E+03	Harrison Reach	9 / 622	1%	1.32E+03	USEPA Region 5	4 / 622	1%
78763-54-9	MONOBUTYL TIN	3.70E+02		5.07E+03		NG/G	1.66E+03	Harrison Reach	7 / 45	16%	--		-- / 45	0%
621-64-7	N-NITROSO-DI-PROPYLAMINE		--		--	--		--	0 / 611	0%	--		-- / 611	0%
95-50-1	O-DICHLOROBENZENE	3.00E+00	DM	6.20E+04	DM	NG/G	1.70E+04	Harrison Reach	10 / 622	2%	2.94E+02	USEPA Region 5	8 / 622	1%

Screening criteria used:

USEPA Region 5, RCRA Ecological Screening Levels.

Table 4-22: PAHs Listed in PREmis Database

TOTAL PAHs	
CAS Number	Chemical
LMW_PAH	LMW PAHs, total (Historical)
HMW_PAH	HMW PAHs, total (Historical)
Total_PAH	PAHs, total (Historical)

High Molecular Weight (HMW) PAHs	
CAS Number	Chemical
218-01-9	Chrysene
53-70-3	Dibenz[a,h]anthracene
206-44-0	Fluoranthene
56-55-3	Benz[a]anthracene
50-32-8	Benzo[a]pyrene
129-00-0	Pyrene

Low Molecular Weight (LMW) PAHs	
CAS Number	Chemical
208-96-8	Acenaphthylene
120-12-7	Anthracene
86-73-7	Fluorene
91-57-6	2-Methylnaphthalene
83-32-9	Acenaphthene
91-20-3	Naphthalene
85-01-8	Phenanthrene

Table 4-23: Statistical Report for Surface Sediment Samples: Total, HMW, and LMW PAHs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Polycyclic Aromatic Hydrocarbons														
Subclass: total PAH														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
Total_PAH	PAHs, total (Historical)	1.50E+03		2.81E+06		NG/G	3.98E+04	Newark Reach	326 / 330	99%	--	--	-- / 330	0%
HMW_PAH	HMW PAHs, total (Historical)	1.50E+03		1.40E+06		NG/G	3.01E+04	Newark Reach	326 / 330	99%	9600	NOAA	288 / 330	87%
LMW_PAH	LMW PAHs, total (Historical)	2.10E+02		1.41E+06		NG/G	1.06E+04	Newark Reach	299 / 330	91%	3160	NOAA	158 / 330	48%

Screening criteria used:

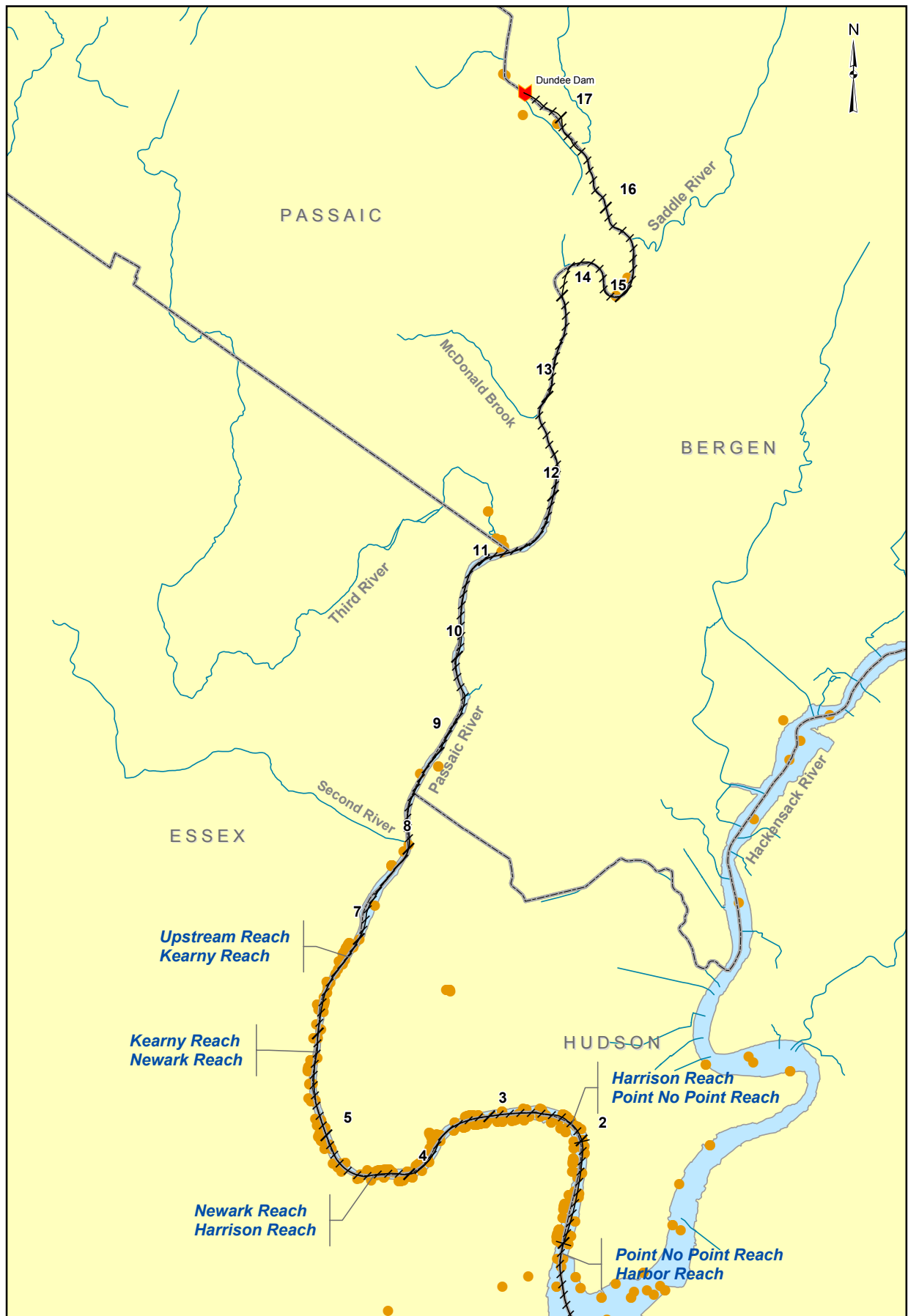
NOAA, 1997: Selected Integrative Sediment Quality Benchmarks for Marine and Estuarine Sediments, ER-M values

Table 4-24: Statistical Report for Subsurface Sediment Samples: Total, HMW, and LMW PAHs

Occurrence, Distribution and Selection of Chemicals of Potential Concern														
CLASS: Polycyclic Aromatic Hydrocarbons														
Subclass: total PAH														
CAS Number	Chemical	Minimum Conc.	Minimum Qualifier	Maximum Conc.	Maximum Qualifier	Units	Average Conc.	Reach of Max Concentration	Detection Frequency	Detection Frequency	Criteria Value(ppb)	Criteria Source	Exceedance Frequency	Exceedance Frequency
Total_PAH	PAHs, total (Historical)	2.20E+02		7.75E+06		NG/G	7.93E+04	Harrison Reach	521/611	85%	--	--	--	--
HMW_PAH	HMW PAHs, total (Historical)	2.20E+02		2.29E+06		NG/G	4.35E+04	Harrison Reach	517/611	85%	9600	NOAA	451/611	74%
LMW_PAH	LMW PAHs, total (Historical)	2.80E+02		5.46E+06		NG/G	3.97E+04	Harrison Reach	474/610	78%	3160	NOAA	322/610	53%

Screening criteria used:

NOAA, 1997: Selected Integrative Sediment Quality Benchmarks for Marine and Estuarine Sediments, ER-M values



0 0.5 1 2 Miles

Historical Data Evaluation  
 Surficial Sediment Sample Locations  
 Figure 1-1

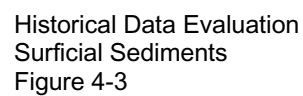
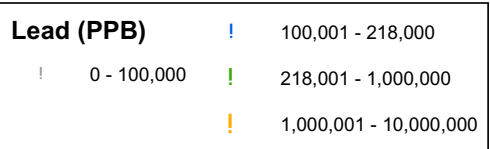


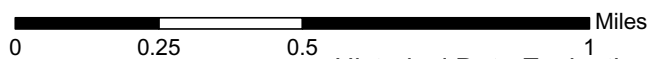
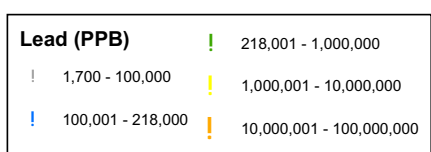
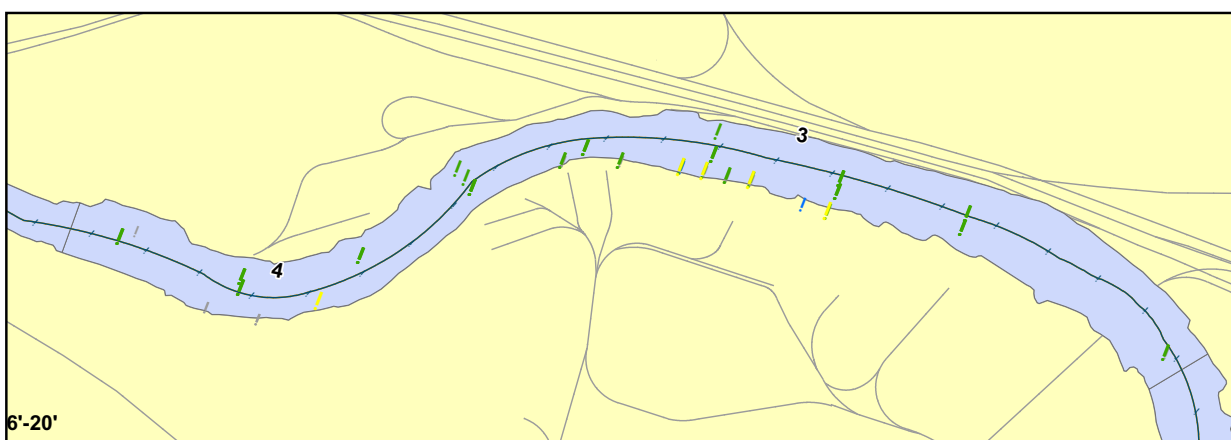
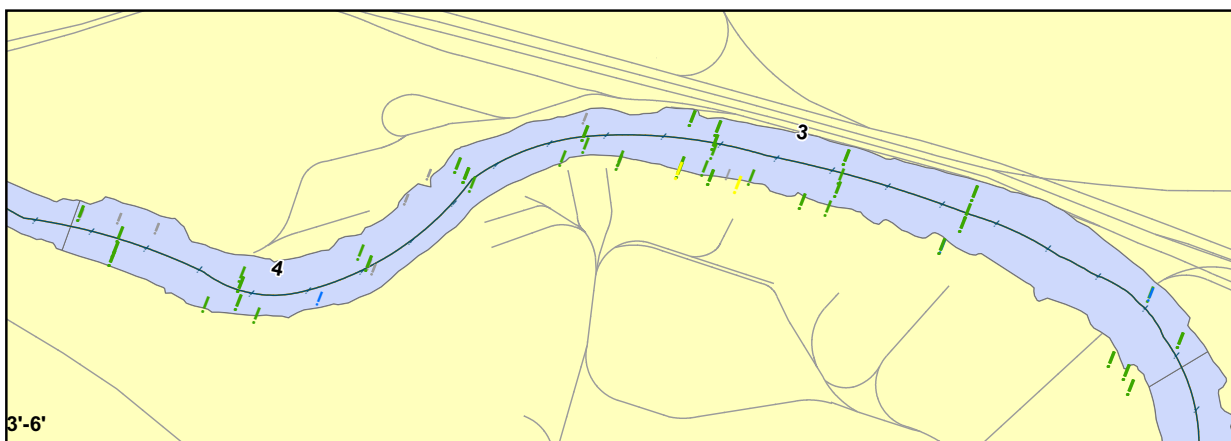
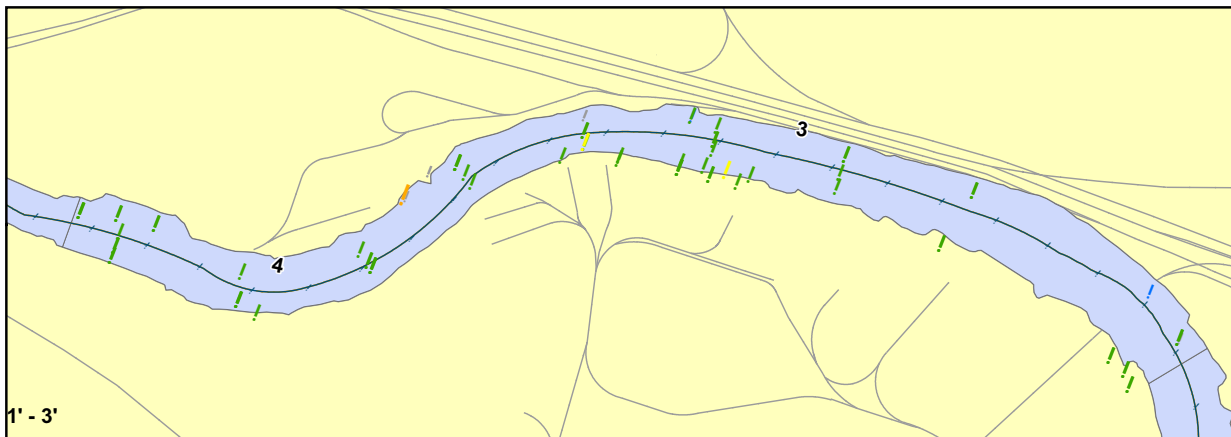
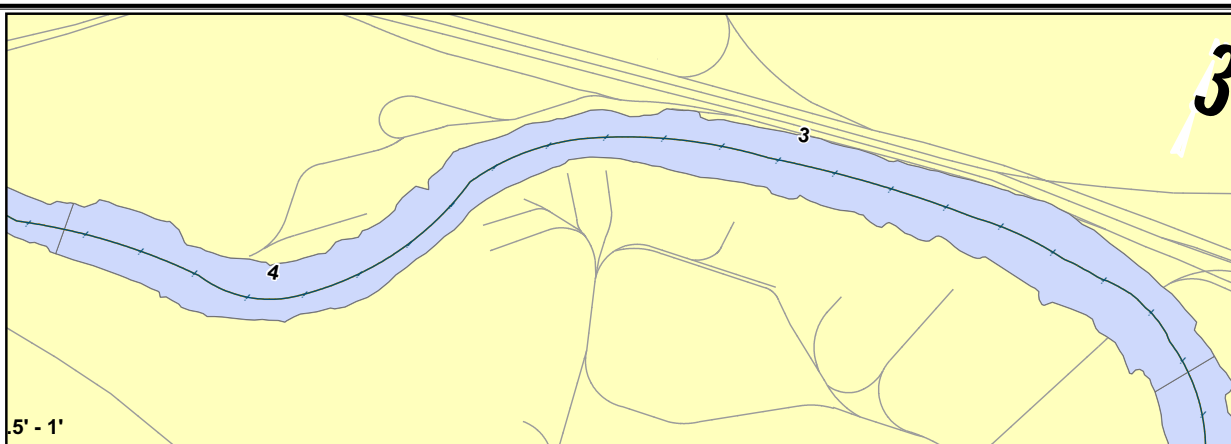




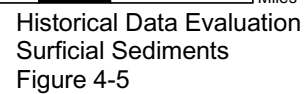
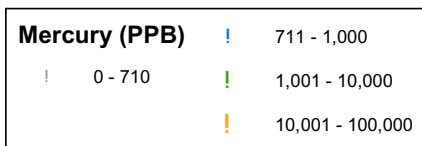


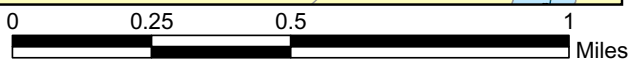
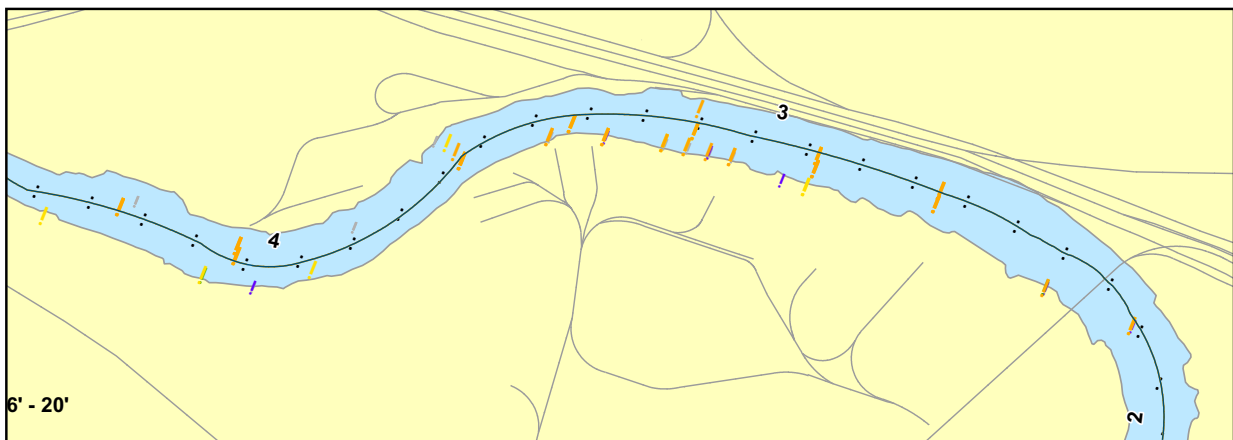
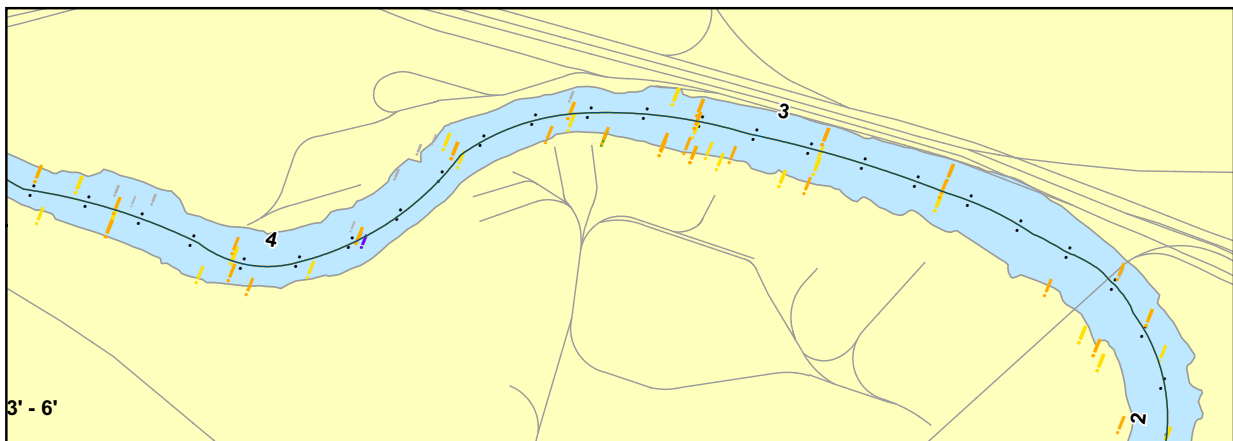
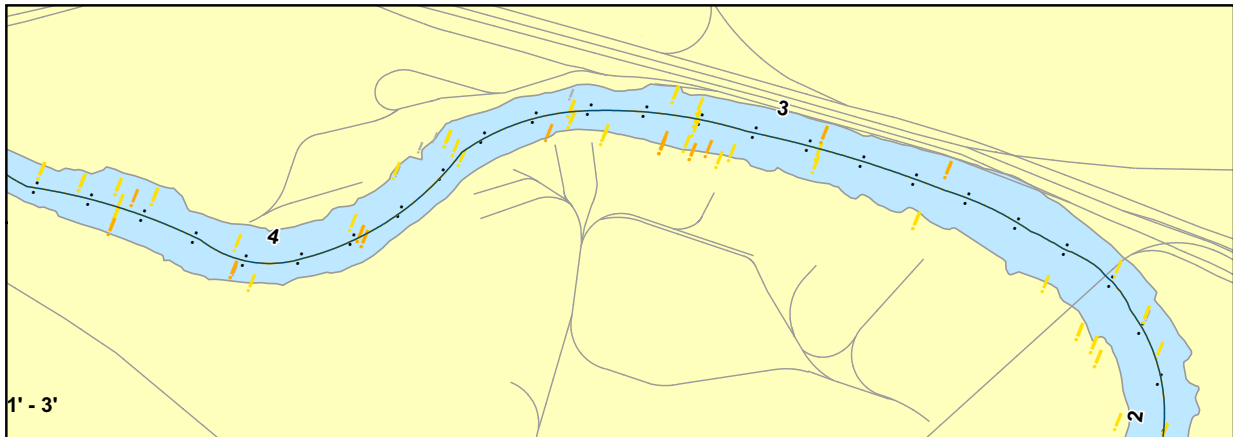
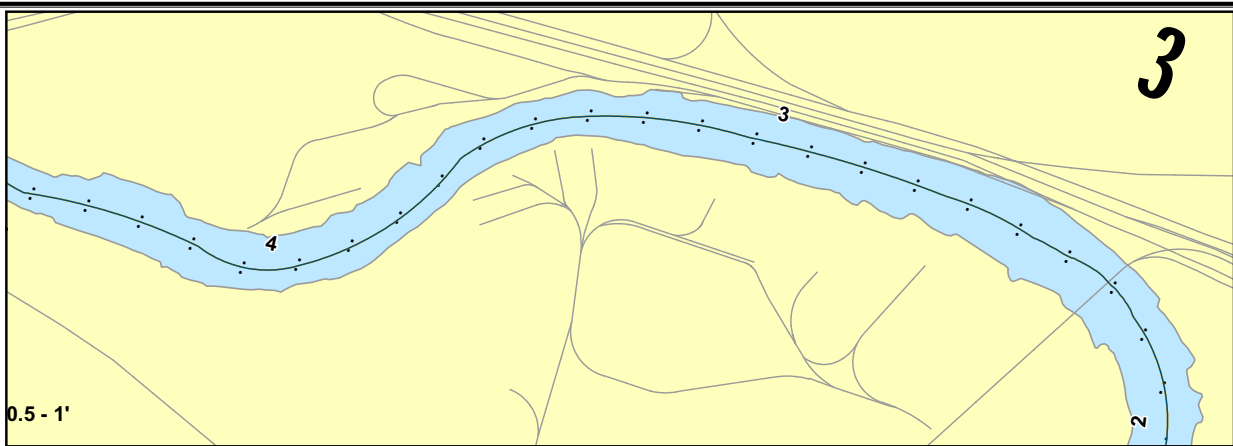




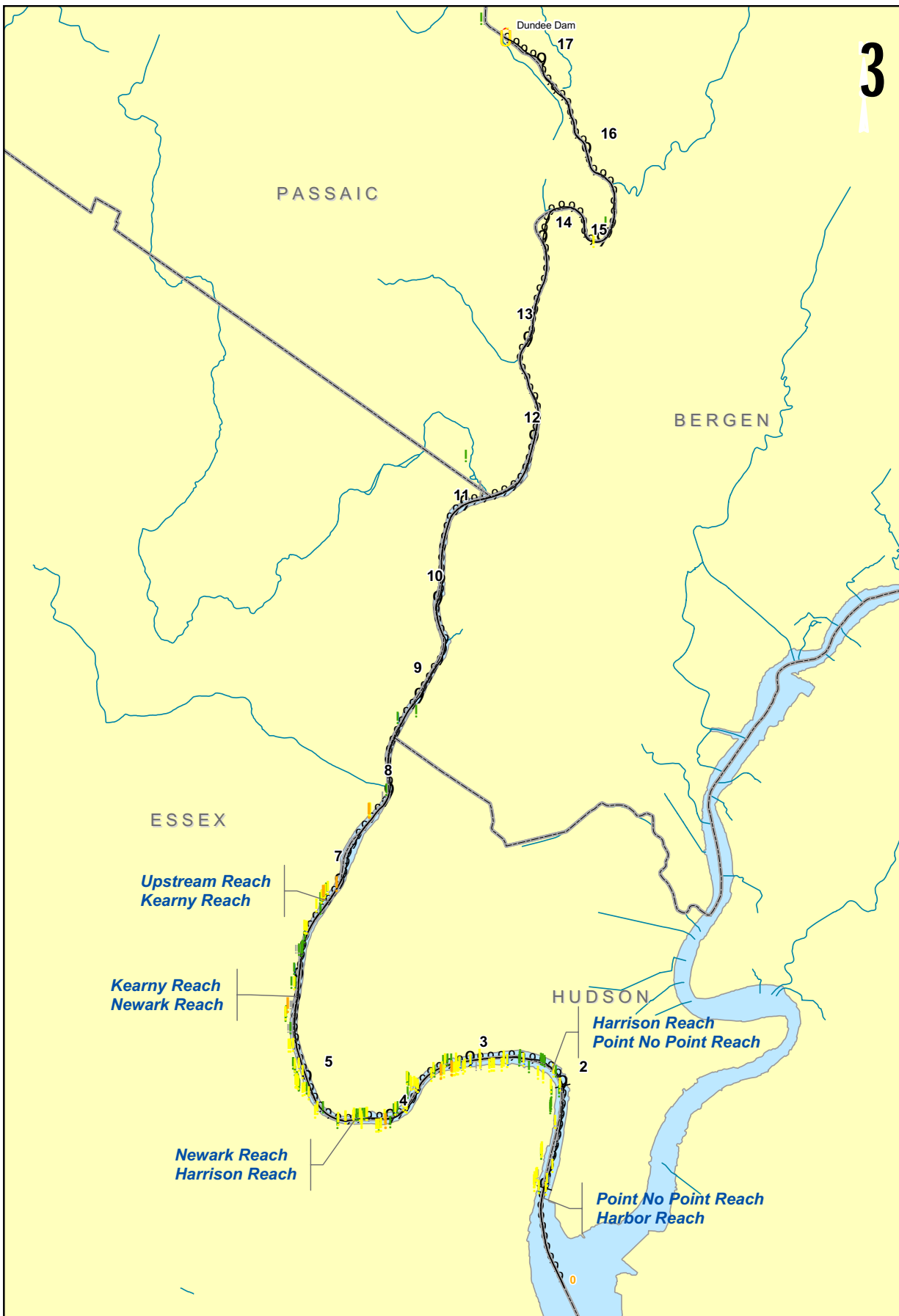


Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-4





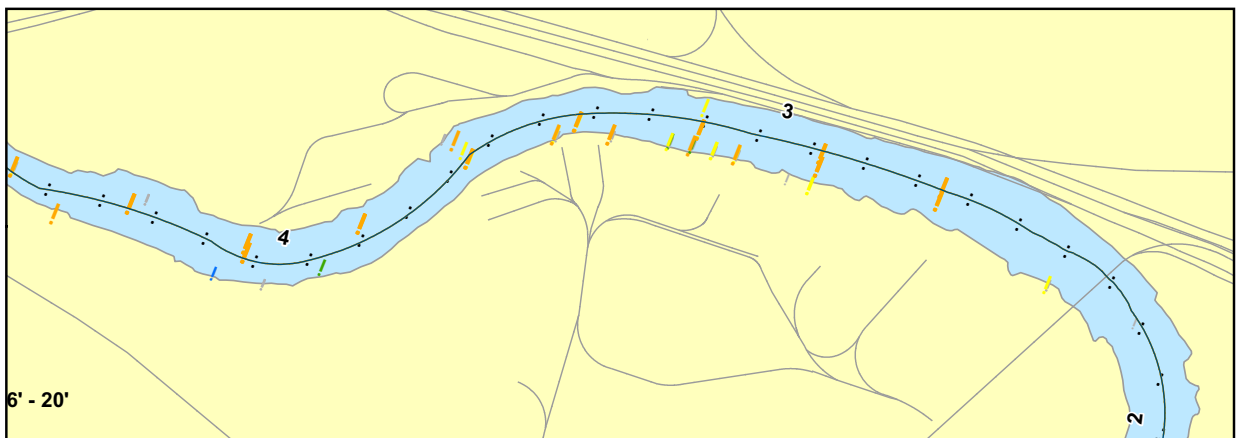
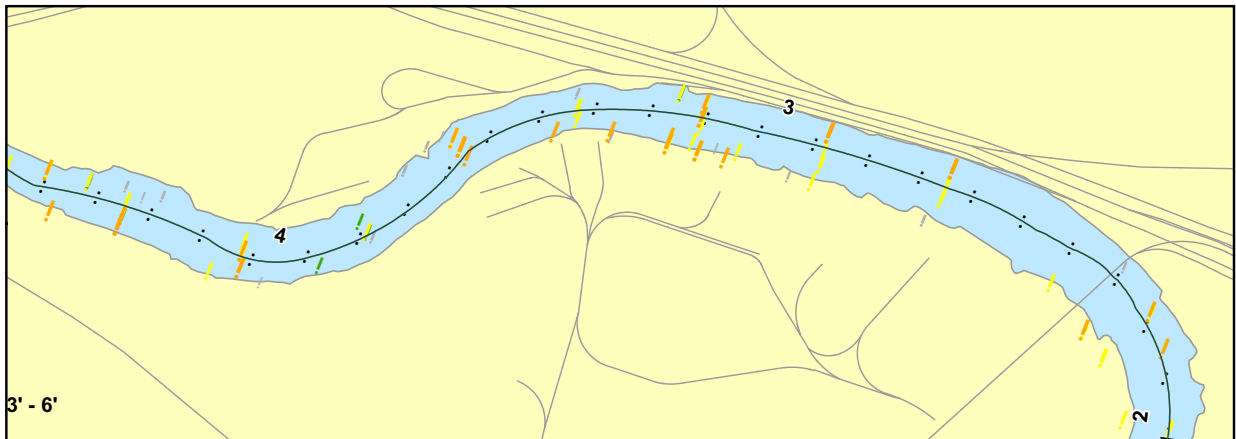
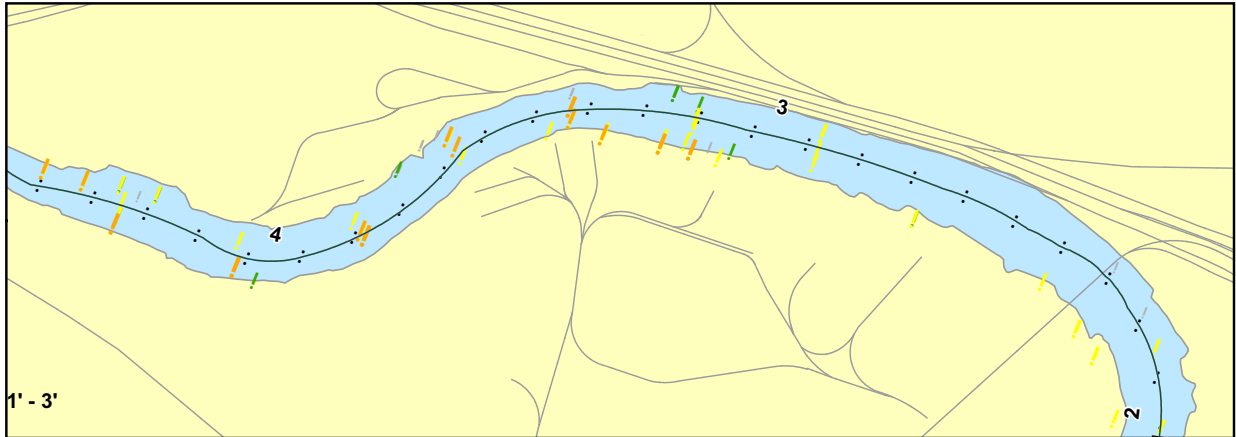
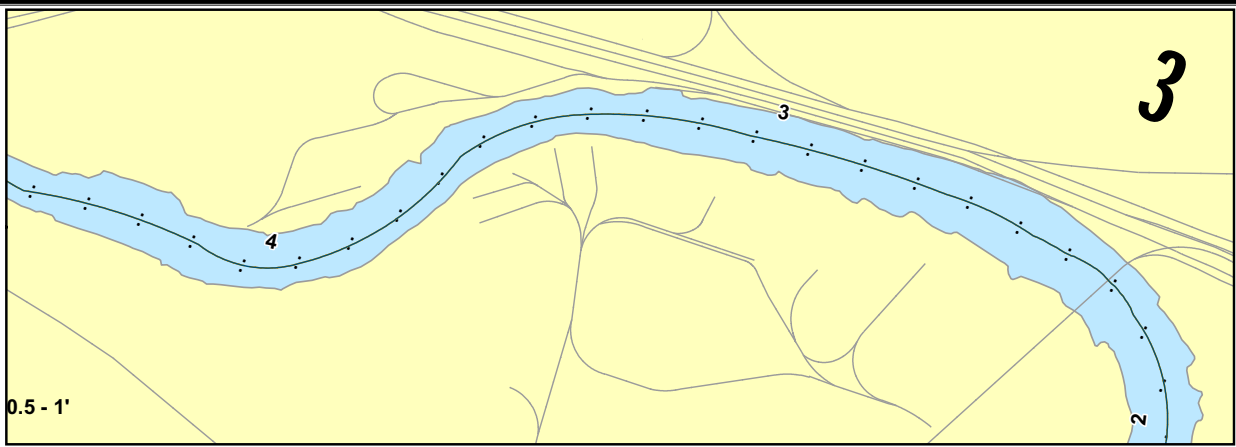
Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-6



Silver (PPB)	
0 - 100	1,001 - 3,700
101 - 1,000	3,701 - 10,000
	10,001 - 100,000

0 0.5 1 2 Miles

Historical Data Evaluation  
Surficial Sediments  
Figure 4-7

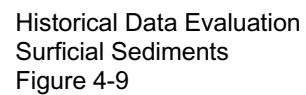
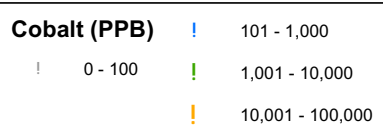


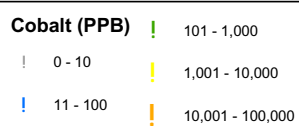
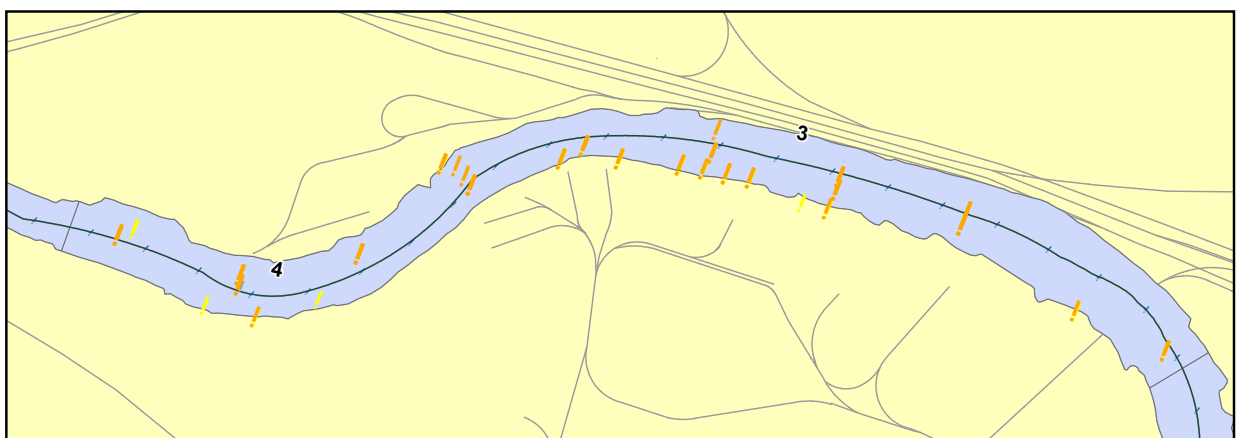
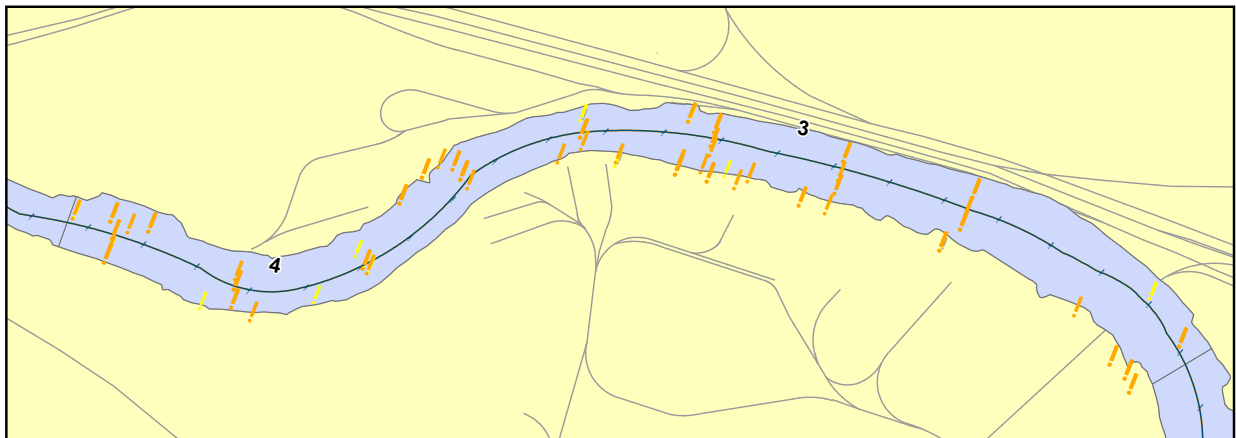
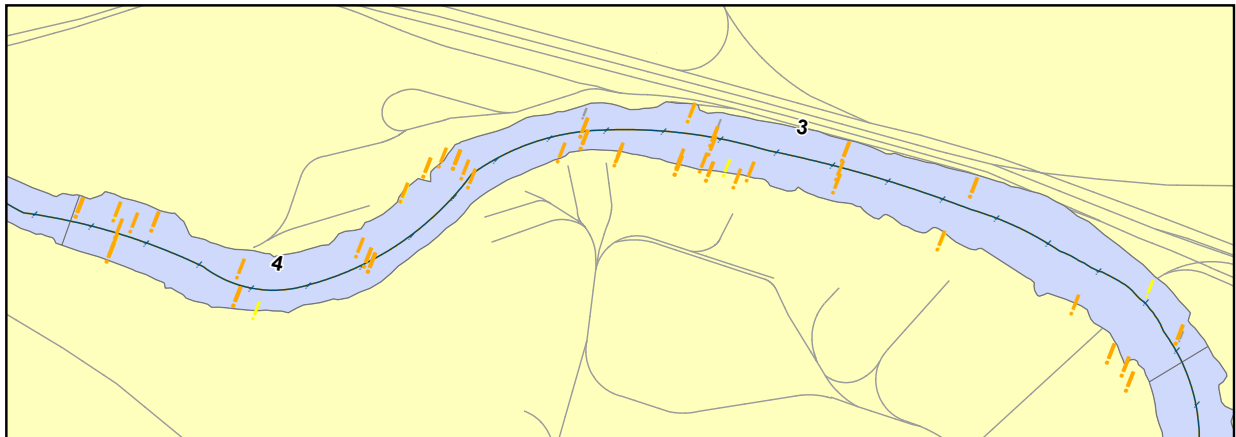
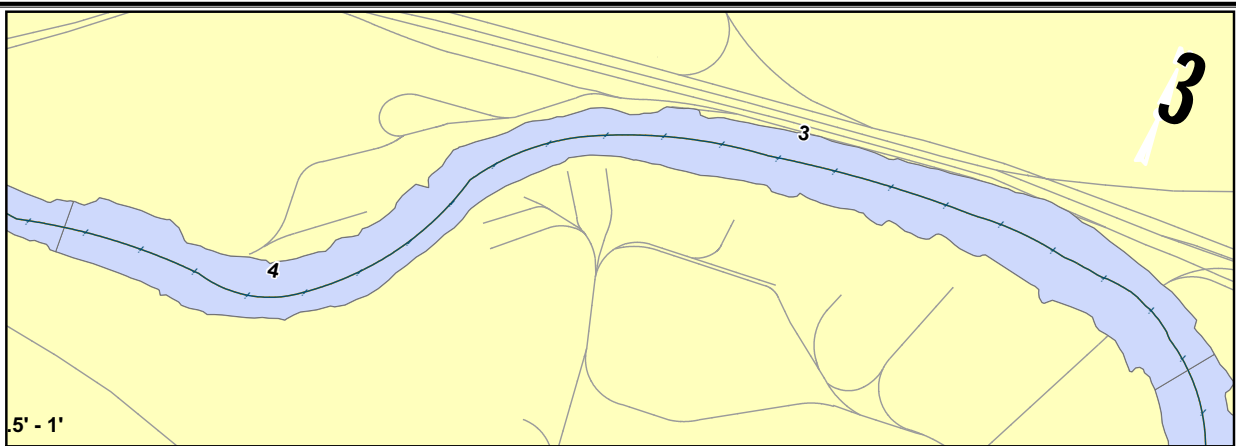
Silver (PPB)	
0 - 100	1,000 - 3,700
100 - 1,000	3,700 - 10,000
	10,000 - 100,000

0 0.25 0.5 1 Miles

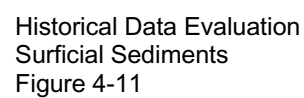
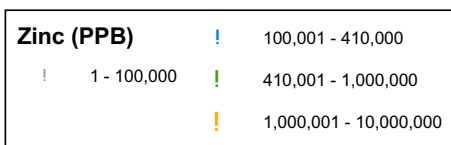
Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-8



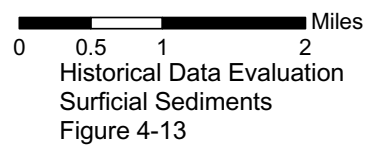
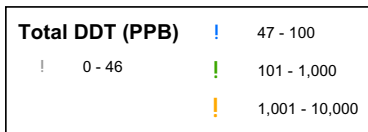




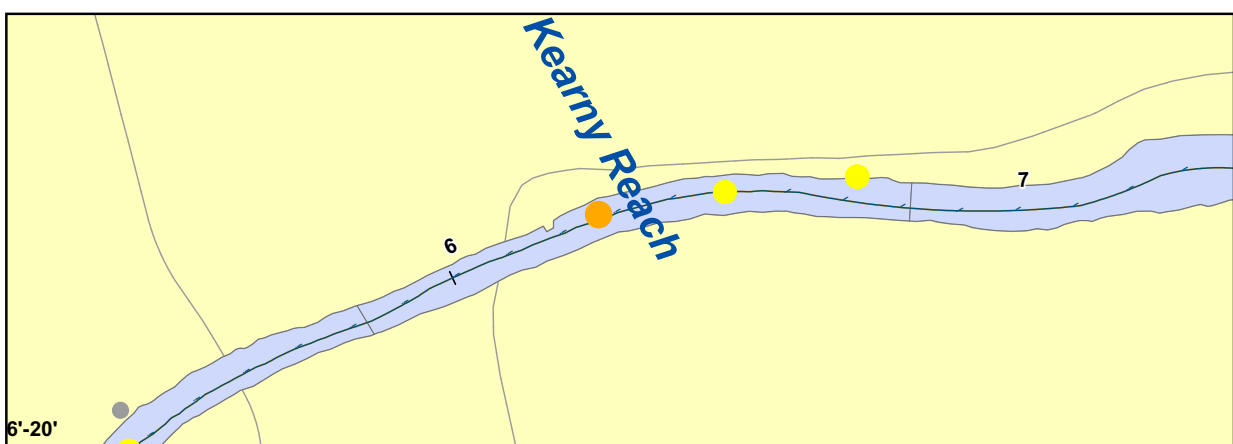
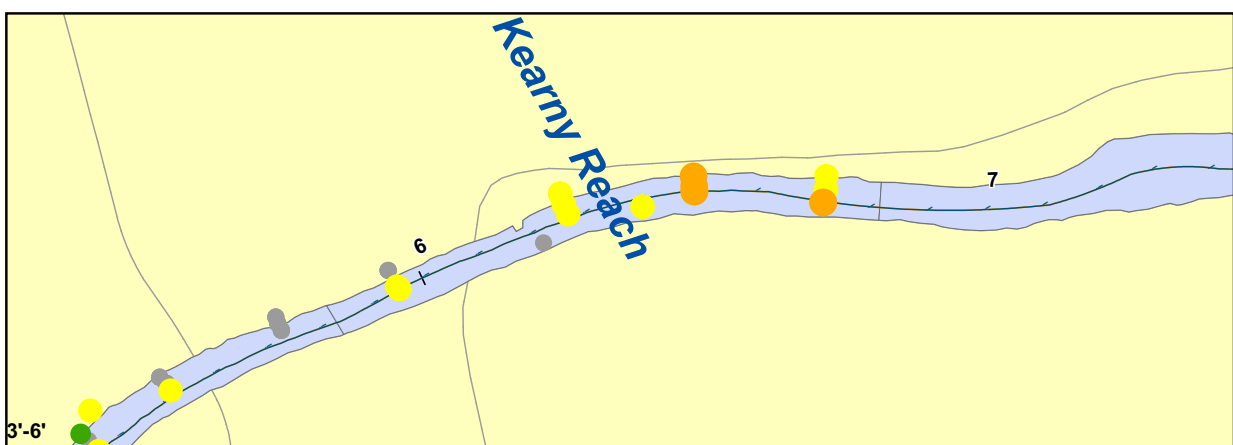
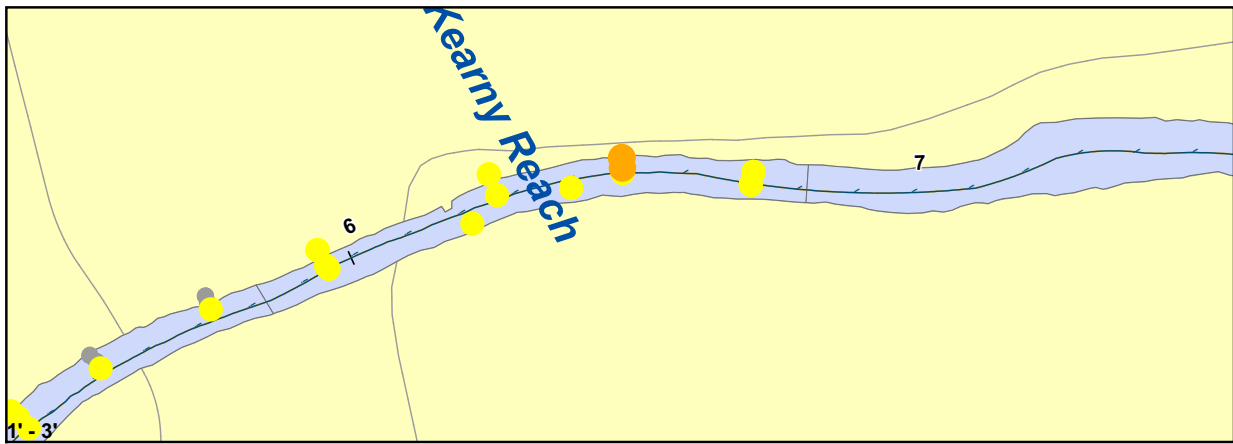
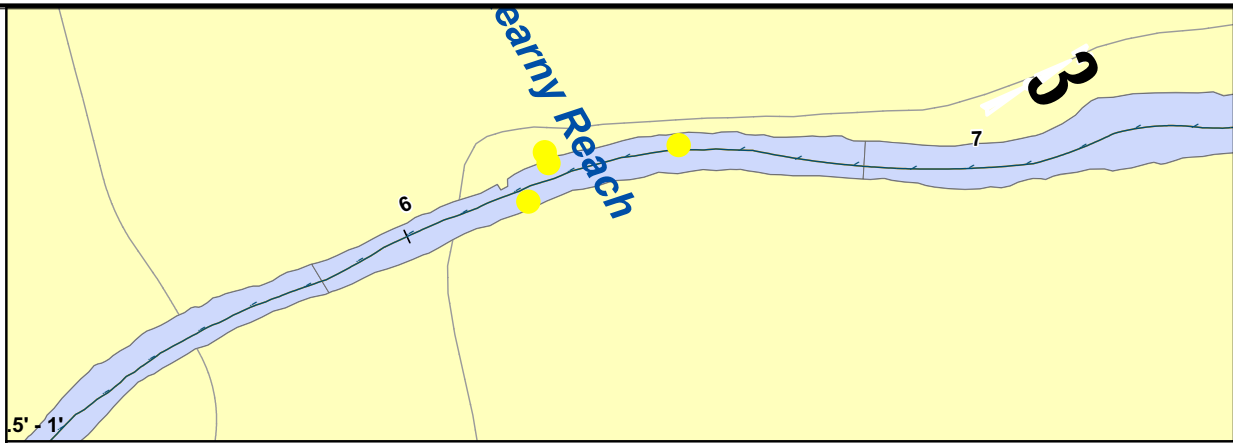
Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-10



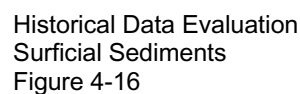
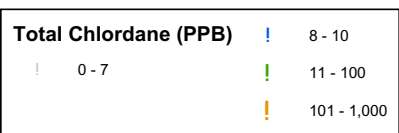




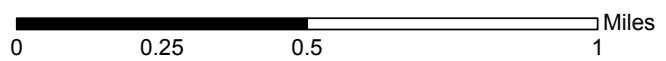
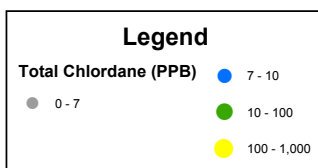
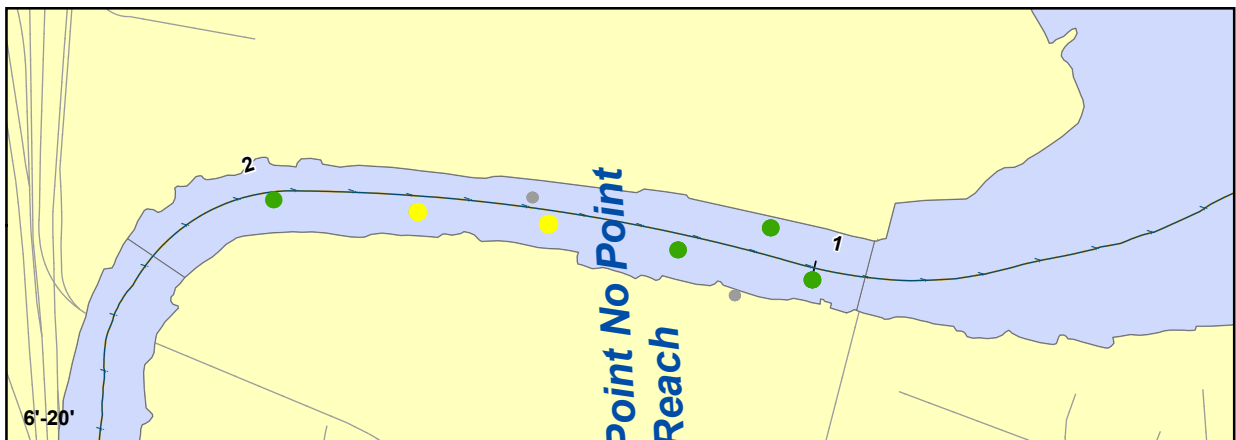
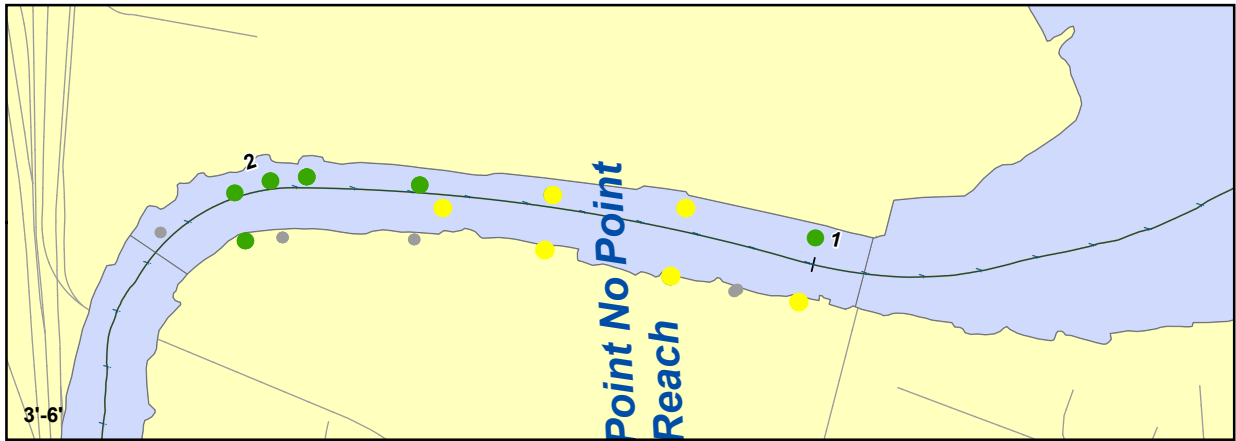
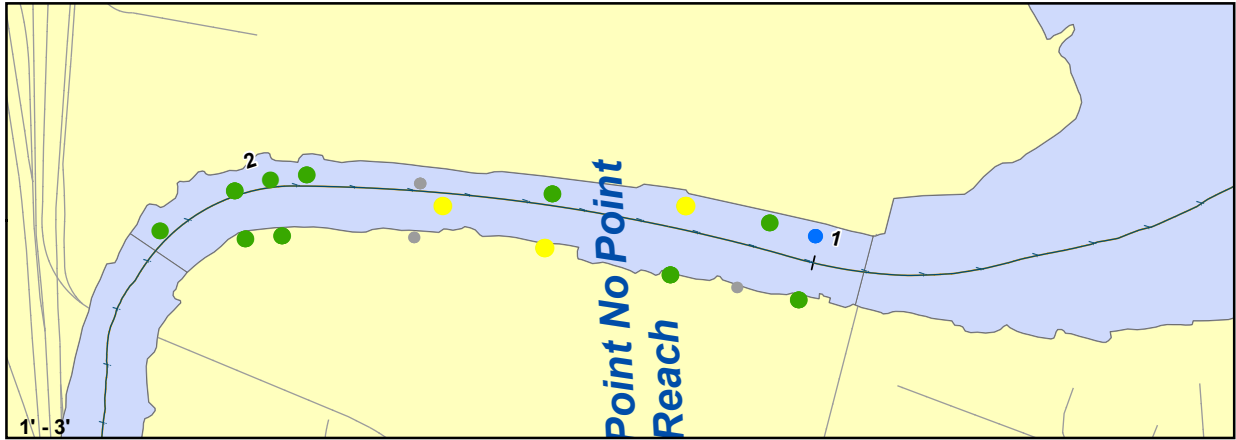
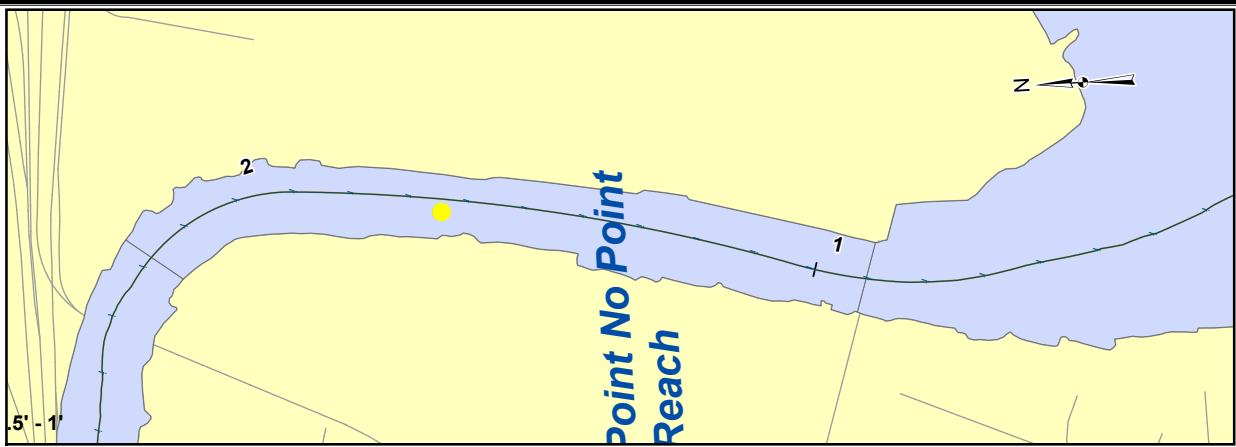




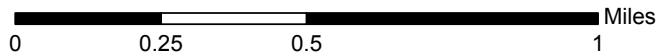
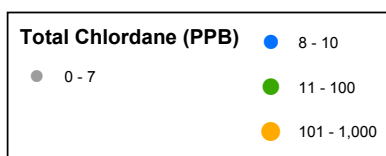
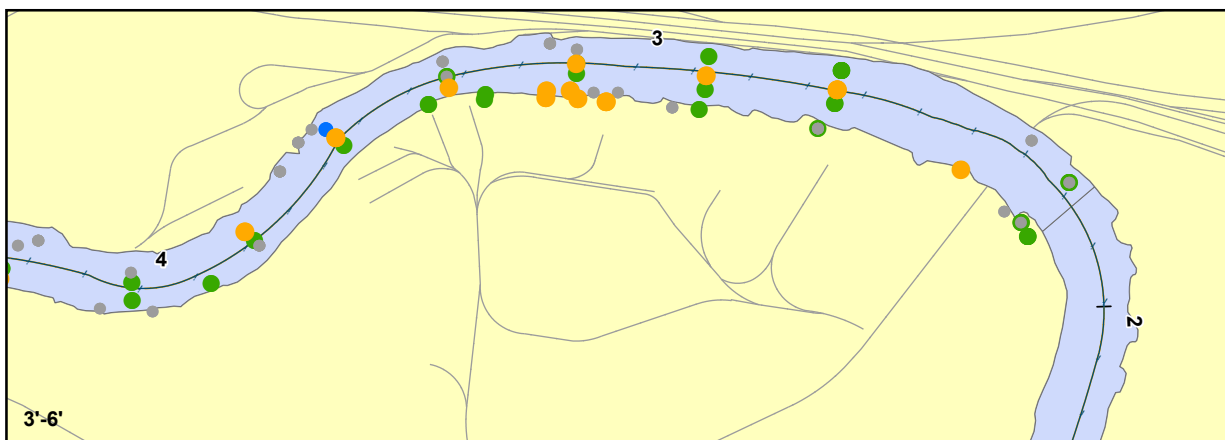
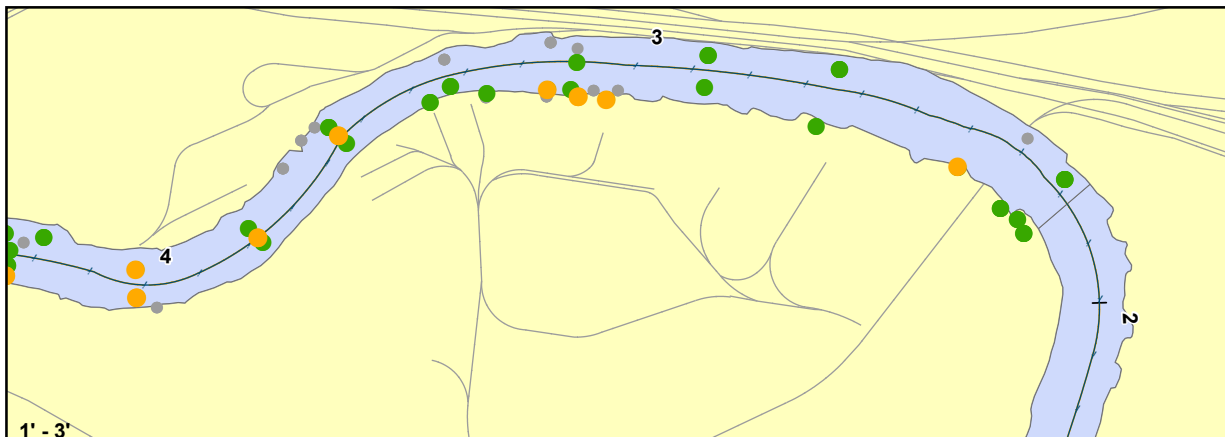
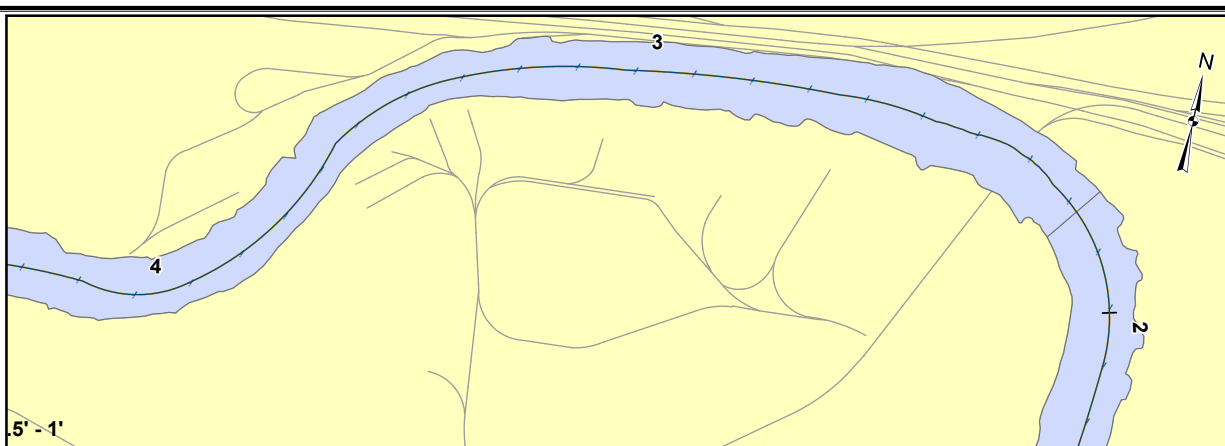
Map Document: C:\Program Files\ESRI\MapDocument\080514\_CDECL\_AMD\History\Subsurface Sediment Newark & Kearny Reaches.mxd







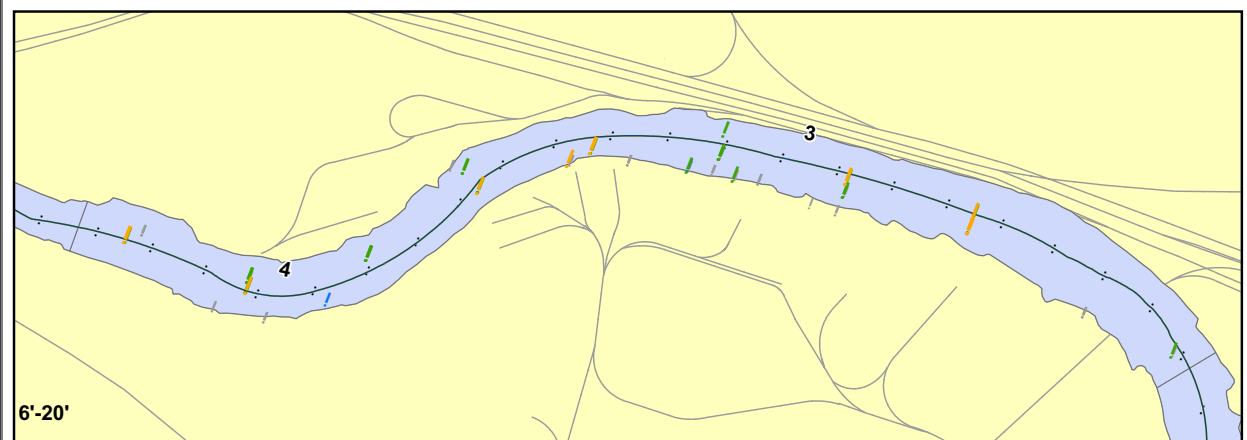
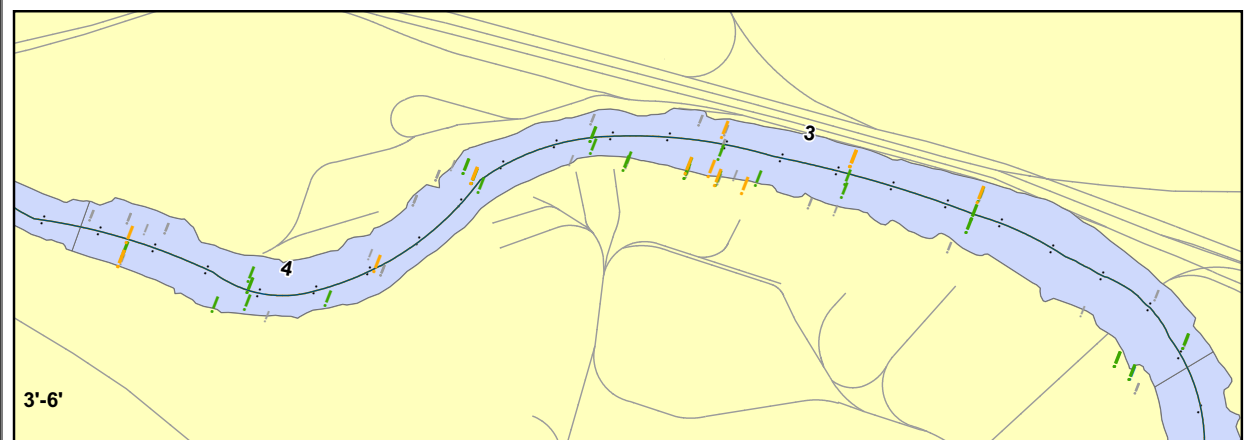
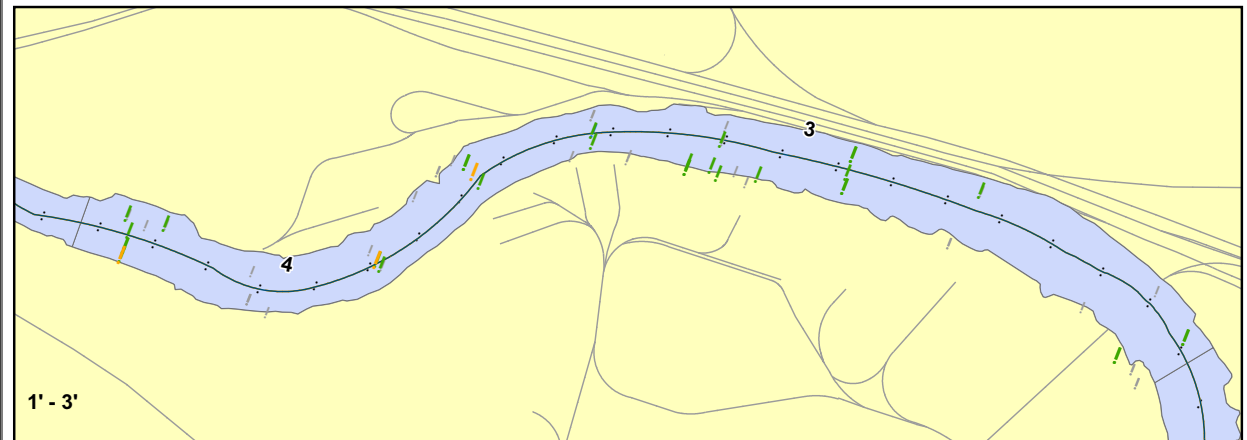
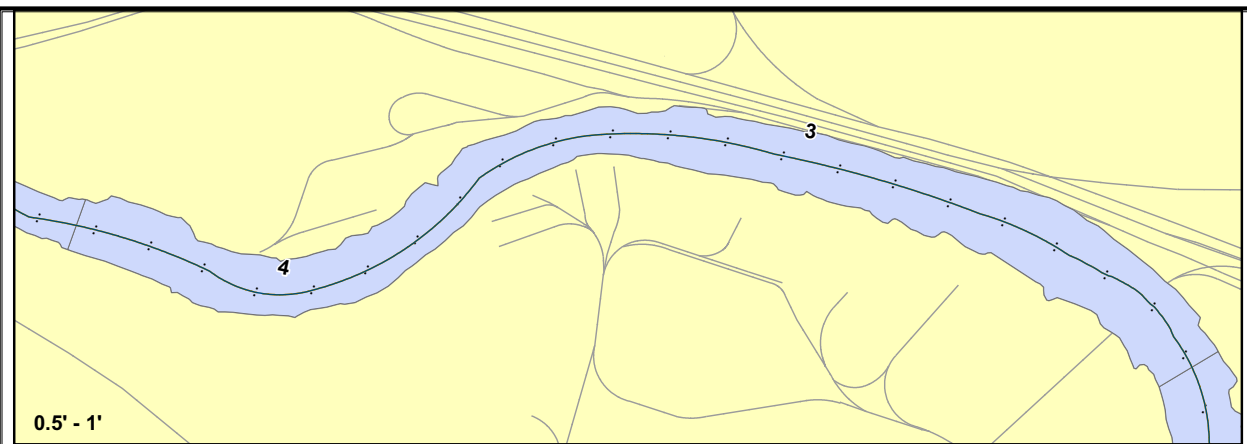
Historical Data Evaluation  
Subsurface Sediment  
Point No Point Reach  
Figure 4-17



Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-18



Historical Data Evaluation  
Surficial Sediments  
Figure 4-19



Dieldrin (PPB)	
0 - 4	5 - 10
11 - 100	101 - 1,000

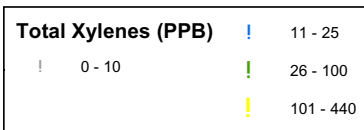
0 0.25 0.5 1 Miles

Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-20



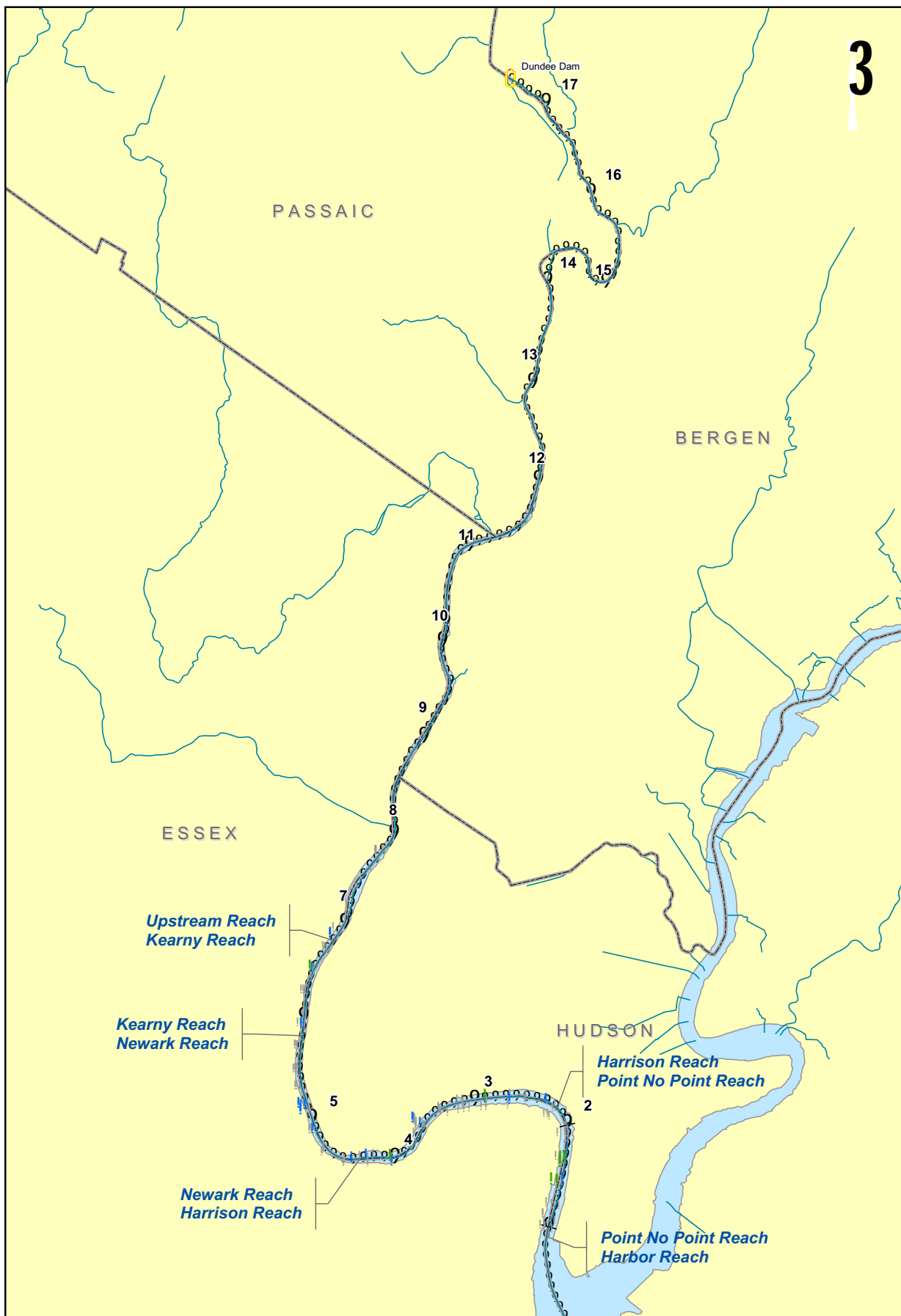
0 0.5 1 2 Miles

Historical Data Evaluation  
Surficial Sediments  
Figure 4-21



0 0.5 1 2 Miles  
Historical Data Evaluation  
Surficial Sediments  
Figure 4-22



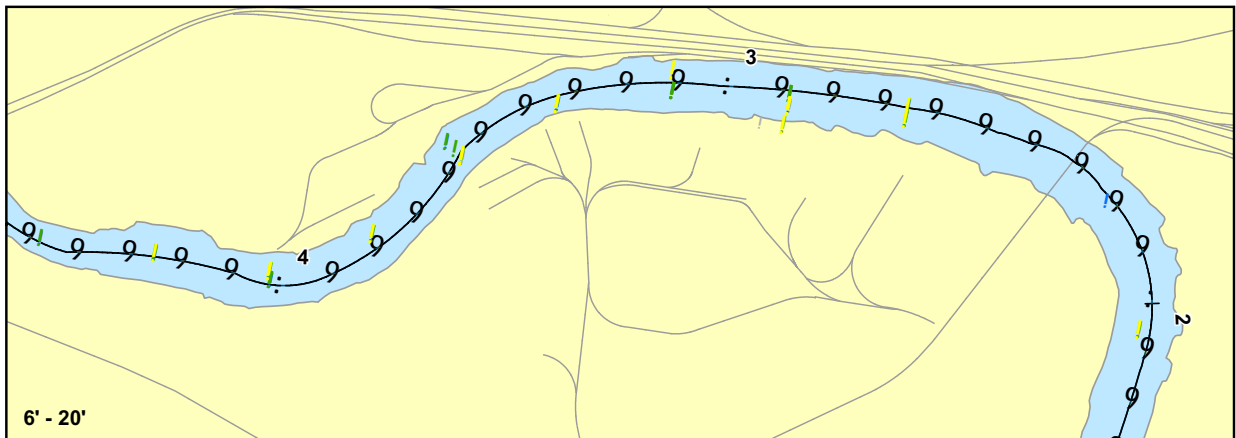
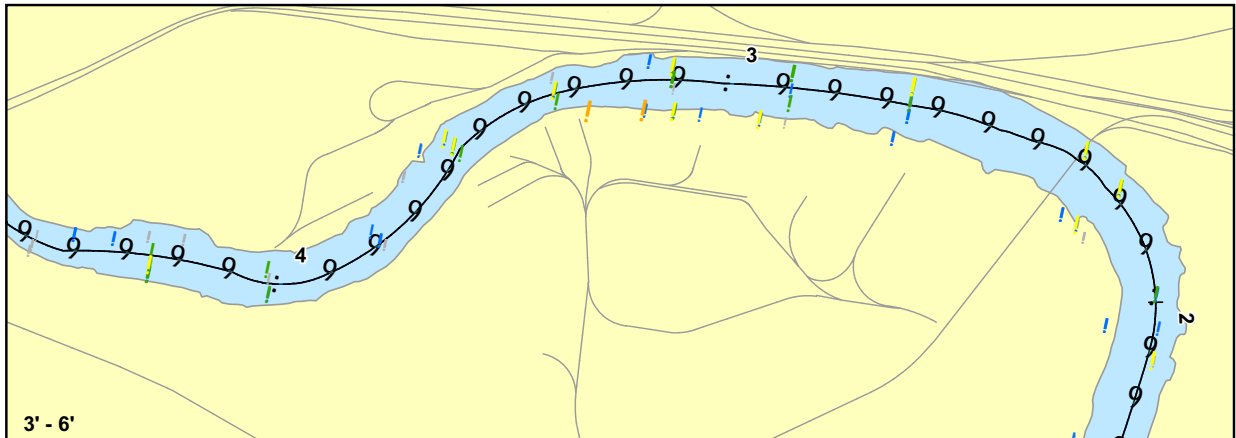
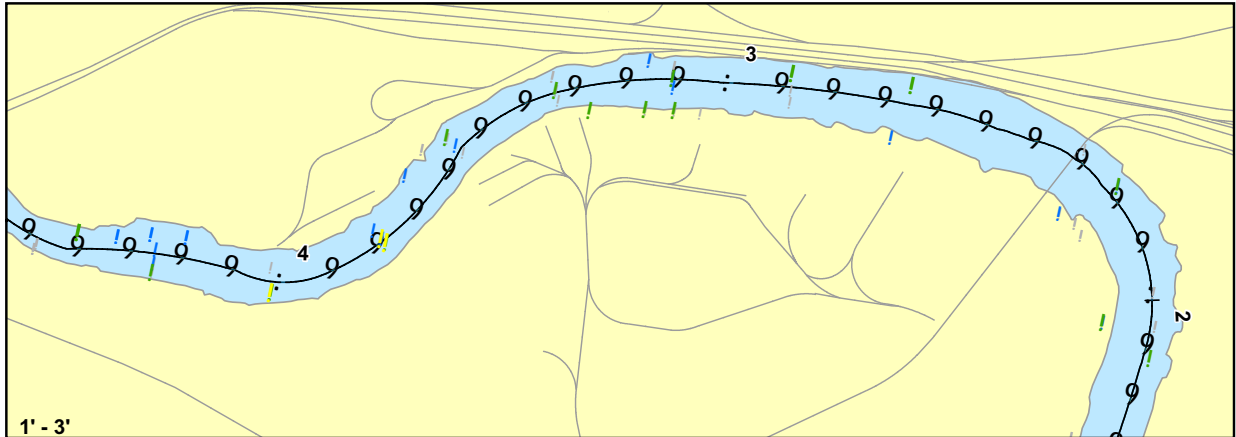
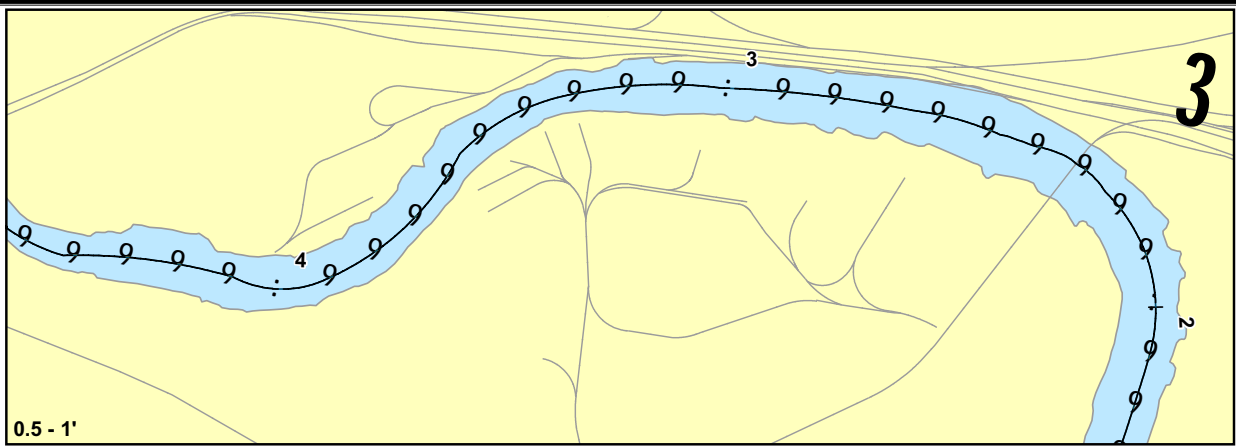


Methyl Ethyl Ketone (PPB)		
0 - 10	11 - 43	44 - 100

0 0.5 1 2 Miles

Historical Data Evaluation  
Surficial Sediments  
Figure 4-24





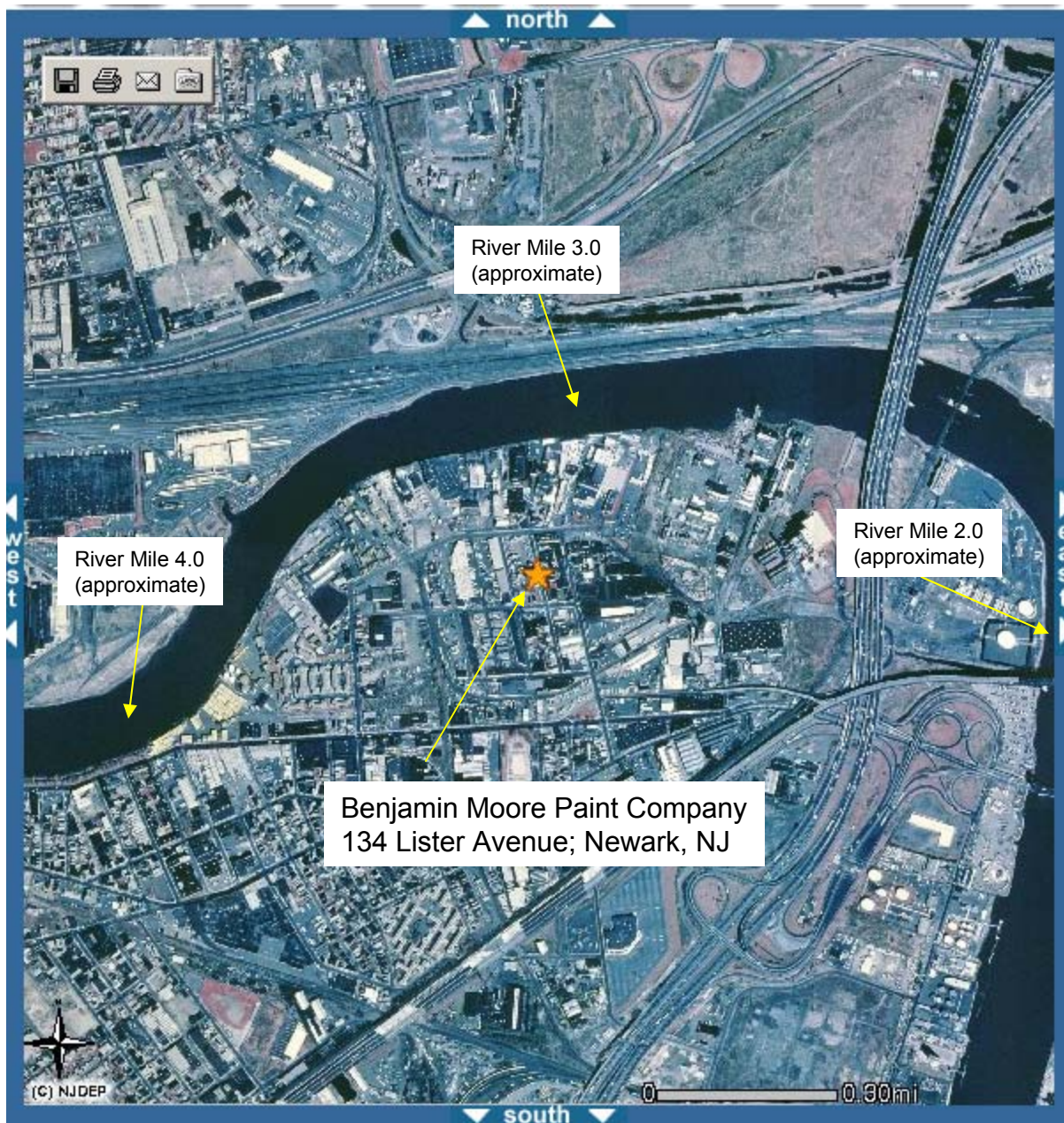
**Methyl Ethyl Ketone (PPB)**

0 - 10	44 - 100
11 - 43	101 - 1,000
	1,001 - 10,000

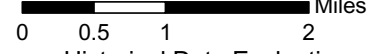
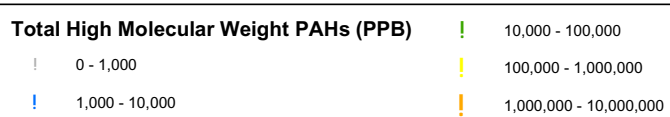
0 0.25 0.5 Miles

Historical Data Evaluation  
Subsurface Sediment  
River Miles 1.75 - 4.5  
Figure 4-25

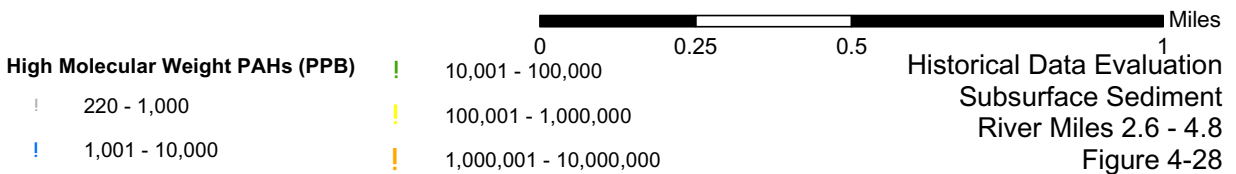
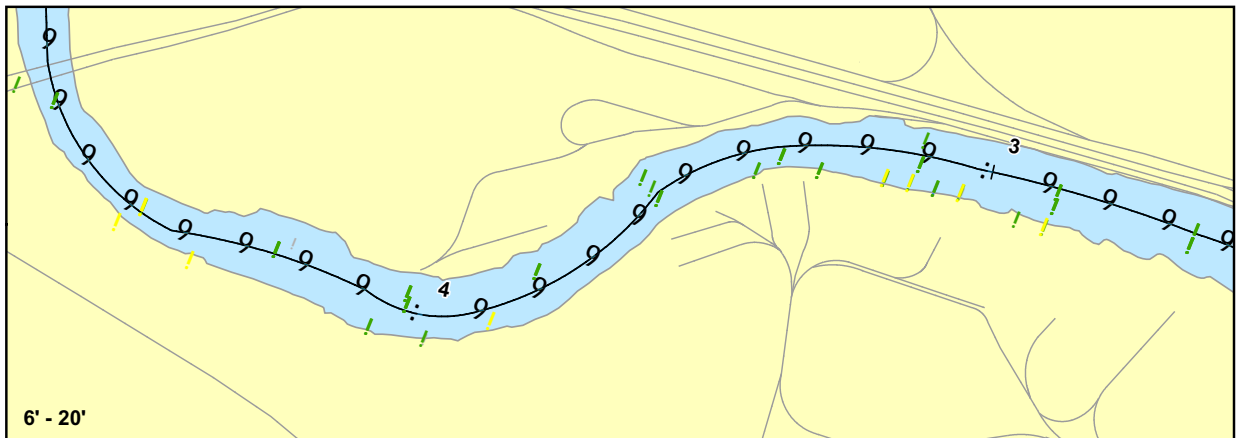
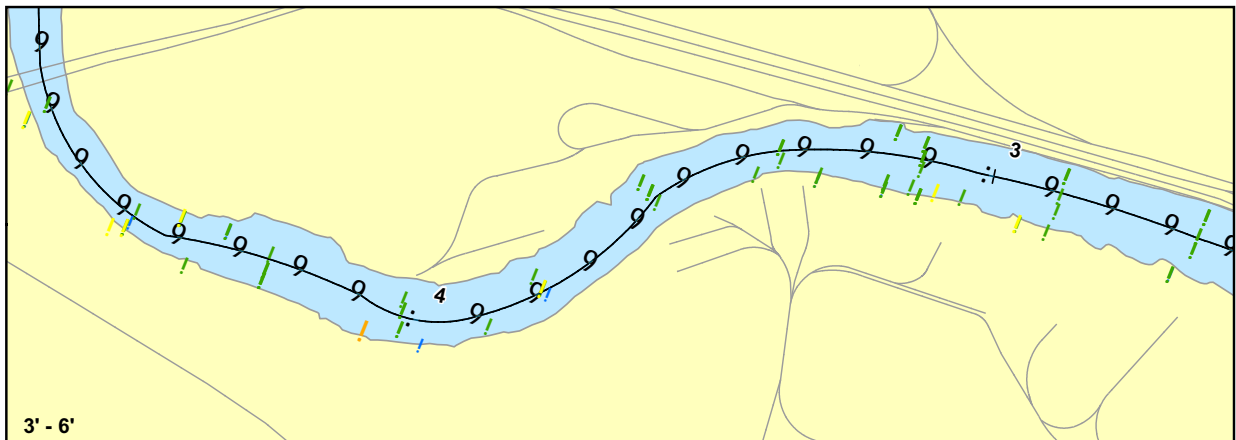
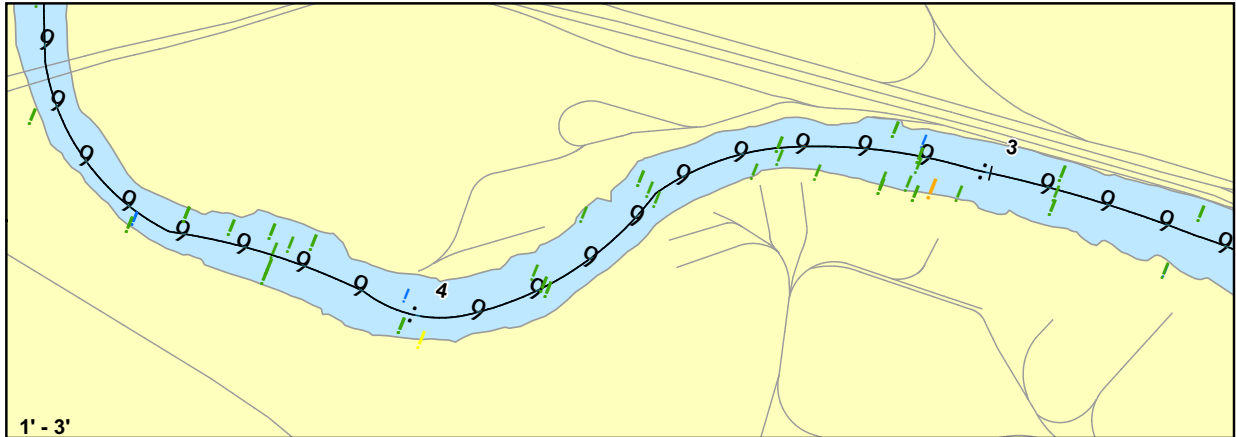
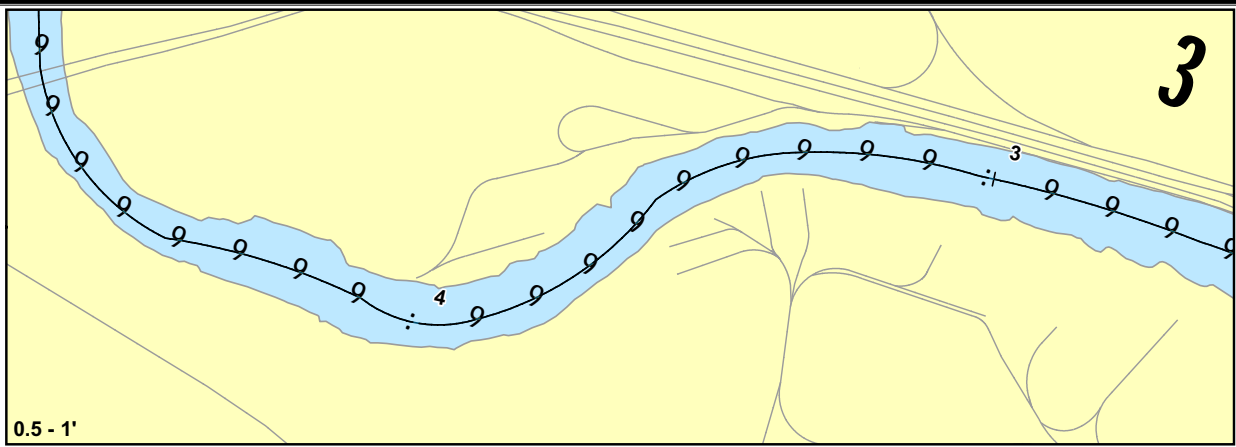
Figure 4-26: Benjamin Moore Paint Company;  
134 Lister Avenue; Newark, NJ 07105



Source: i-Map, NJ. Copyright © State of New Jersey, 1996-2002. Accessed April 30, 2004.  
New Jersey Department of Environmental Protection; P.O. Box 402; Trenton, NJ 08625-0402.  
<http://www.state.nj.us/dep/gis/imapnj/imapnj.htm#>



Historical Data Evaluation  
Surficial Sediments  
Figure 4-27







### Low Molecular Weight PAHs (PPB)

! 0-1000

1000-10000

!

10000-100000

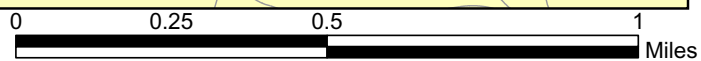
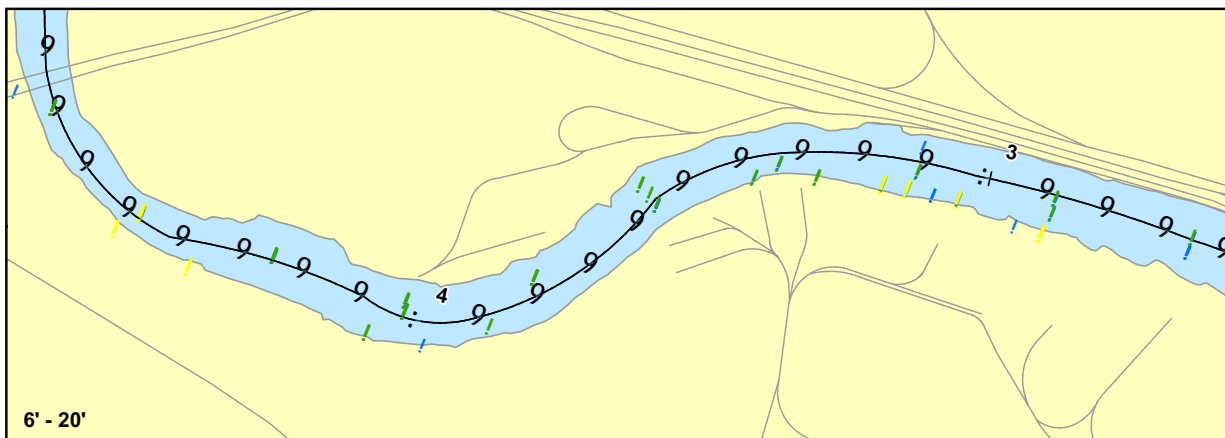
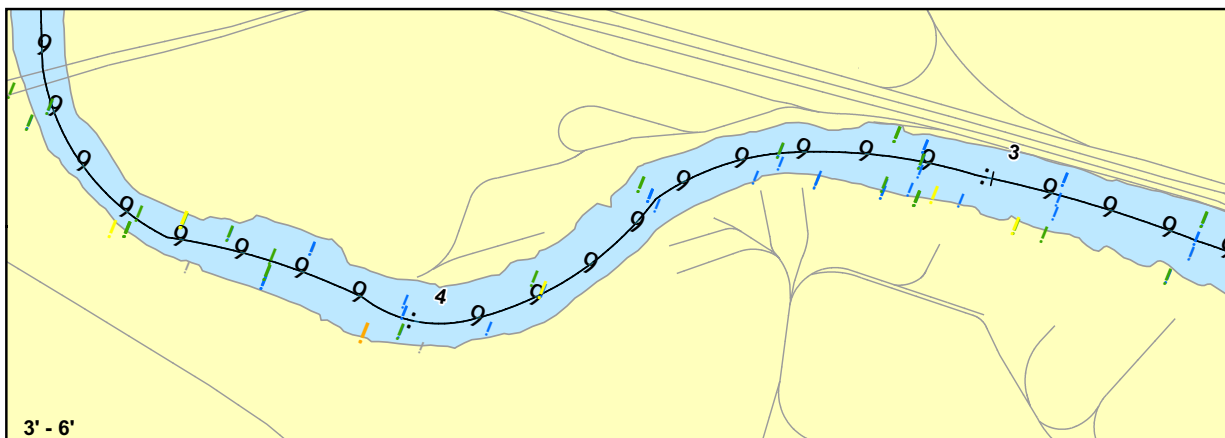
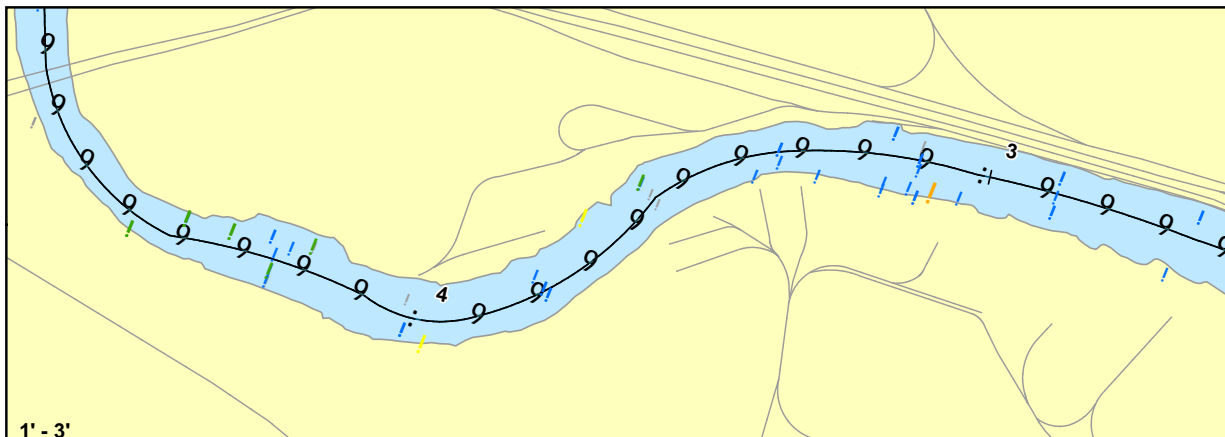
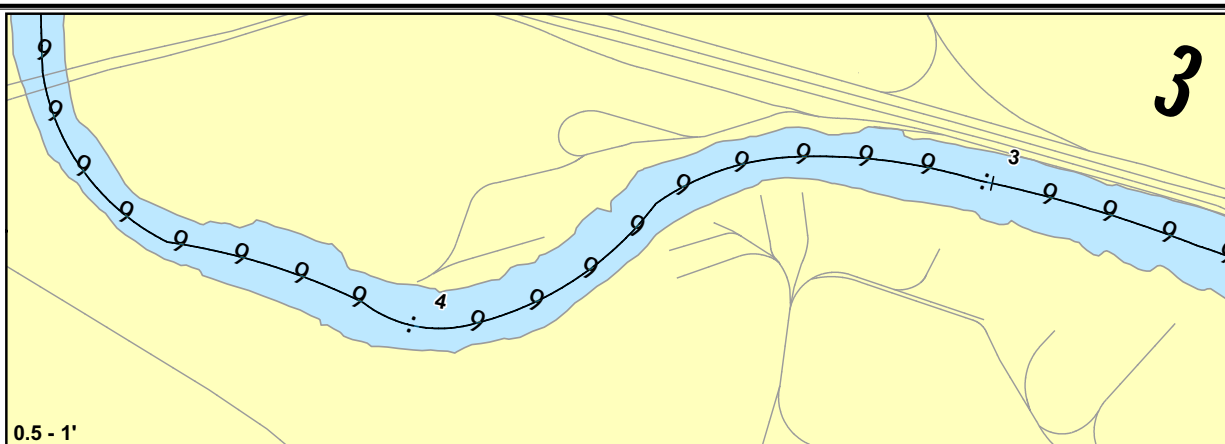
100000-1000000

1

1000000-10000000

A horizontal number line is shown with tick marks at 0, 0.5, 1, and 2. The word "Miles" is written at the right end of the line. A white rectangular segment is highlighted between the 0.5 and 1 marks, representing the distance from the school to the park.

Historical Data Evaluation  
Surficial Sediments  
Figure 4-29



### Low Molecular Weight PAHs (PPB)

! 180 - 1,000

! 1,001 - 10,000

!

1



10,001 - 100,000

100,001 - 1,000,000

1,000,001 - 10,000,000

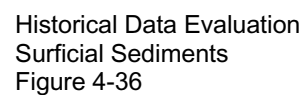
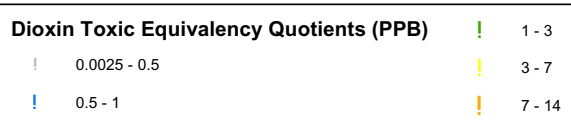
Historical Data Evaluation  
Subsurface Sediment  
River Miles 2.6 - 4.8  
Figure 4-30



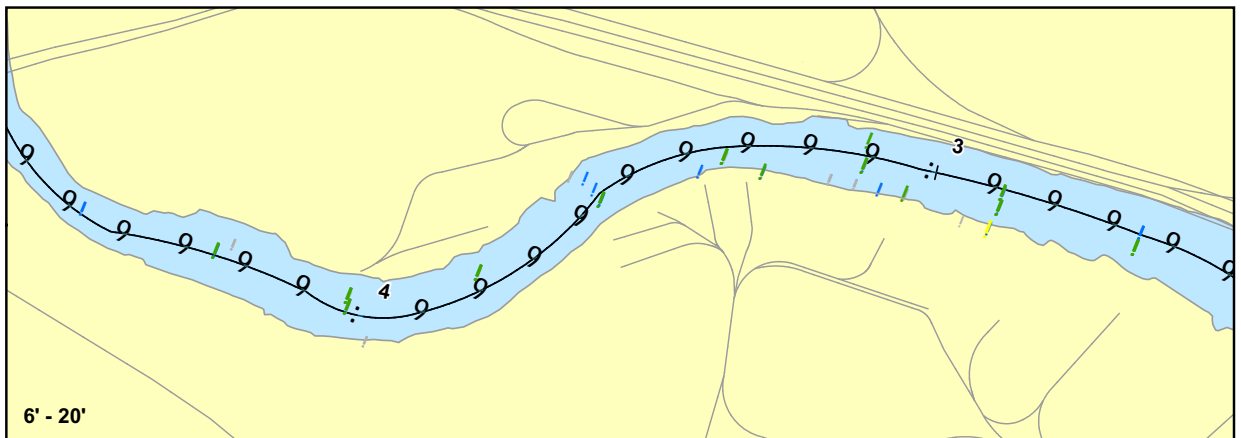
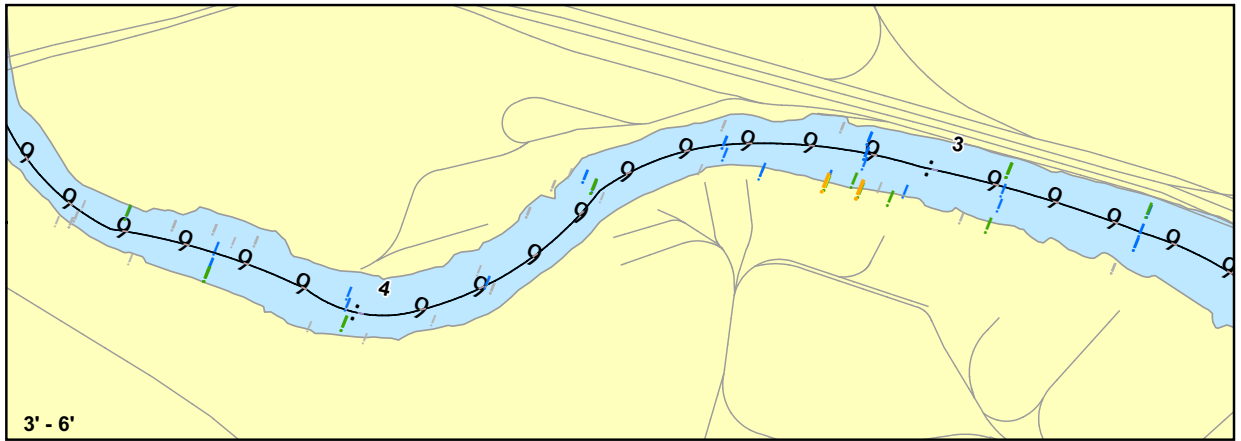
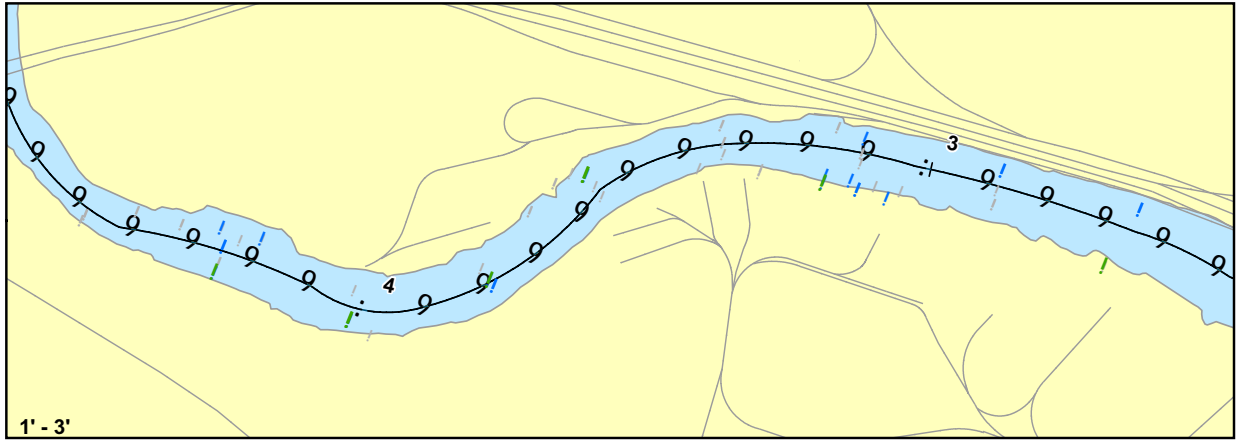
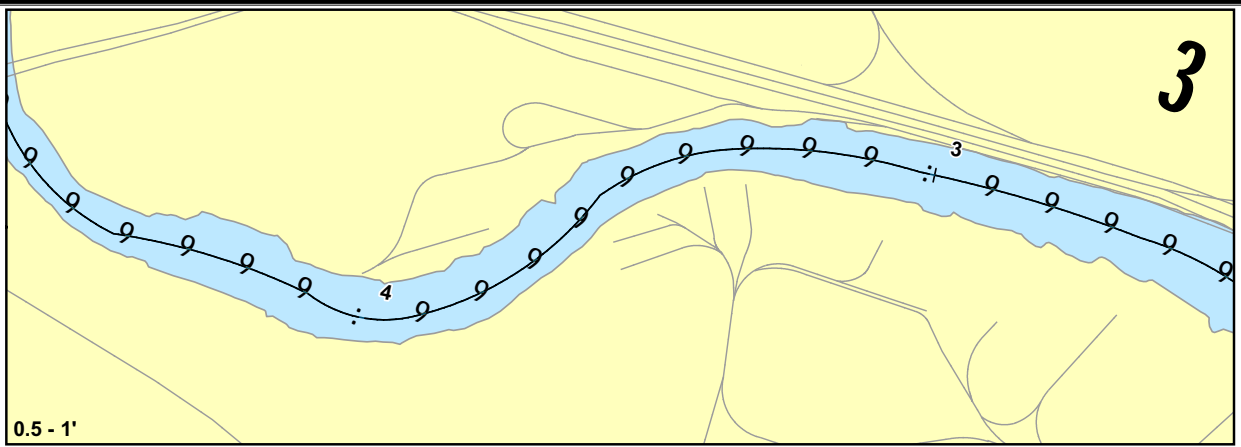












0 0.25 0.5 1 Miles

Dioxin Toxic Equivalency Quotients (PPB)

0 - 1  
2 - 10

11 - 100  
101 - 1,000  
1,001 - 10,000

Historical Data Evaluation  
Subsurface Sediment  
Harrison Reach  
Figure 4-38